A330
TECHNICAL TRAINING MANUAL
MECHANICAL & AVIONICS COURSE - T1+T2 (LVL 2&3)
(RR Trent 700)
FIRE PROTECTION

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FIRE PROTECTION

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FIRE PROTECTION LINE MAINTENANCE BRIEFING (2)

SYSTEM OVERVIEW

The engine and APU fire protection is fulfilled by two sub-systems: the fire detection system and the fire extinguishing system.

ENGINE FIRE PROTECTION

Engine fire protection is done by two systems: the fire detection system and the fire extinguishing system. The engine Fire Detection Unit (FDU) monitors two engine detector loops. Each loop has detector elements located in critical engine areas and connected in parallel. Each engine type has a unique configuration of detector element locations. Warnings are generated according to an AND logic (both loops detect a FIRE). There are two fire bottles located in the engine pylon for engine FIRE extinguishing. The engine fire protection system gives aural and visual indications for FIRE and FAULT conditions.

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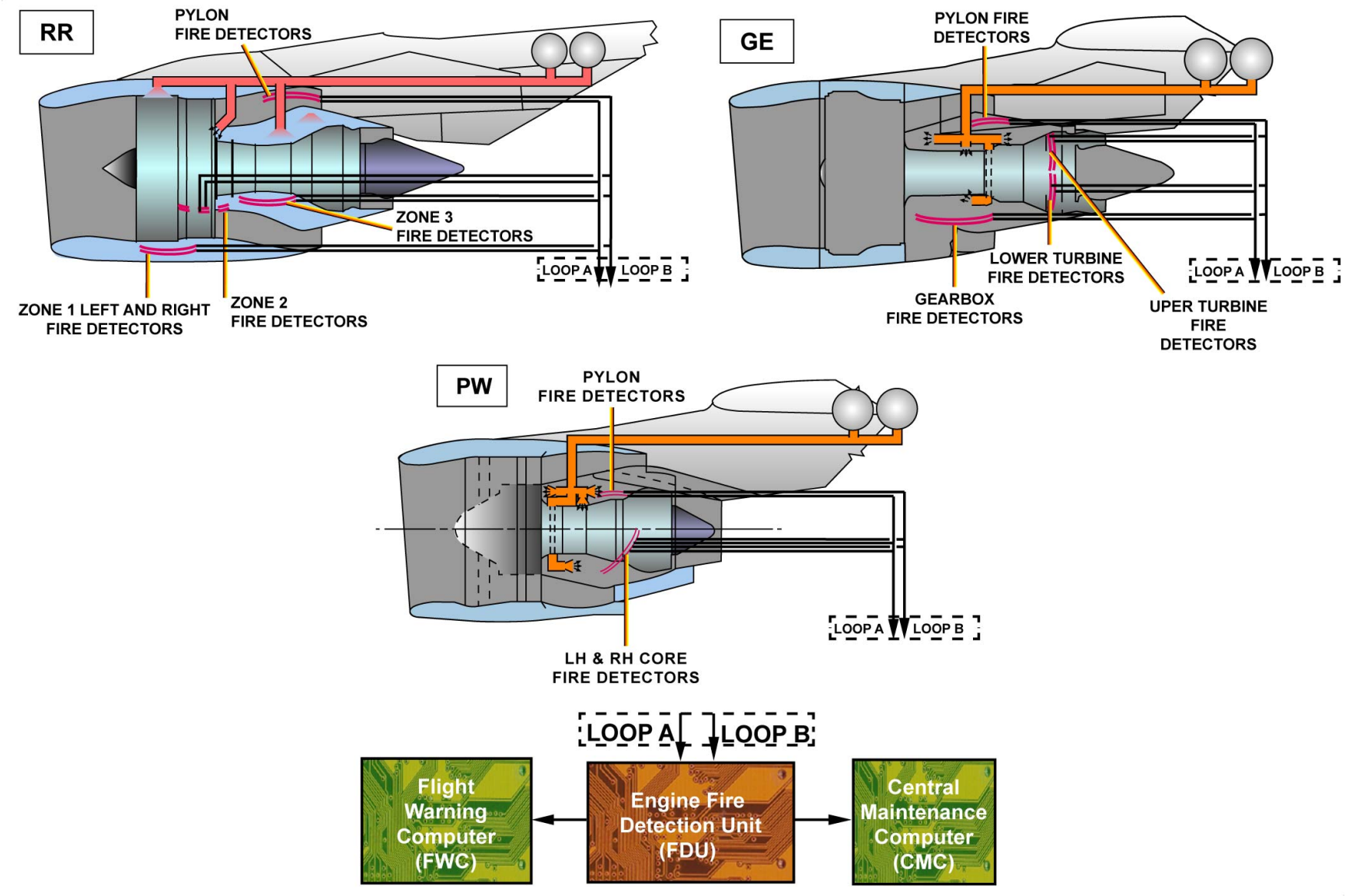

SYSTEM OVERVIEW - ENGINE FIRE PROTECTION

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FIRE PROTECTION LINE MAINTENANCE BRIEFING (2)

SYSTEM OVERVIEW (continued)

APU FIRE PROTECTION

The APU fire protection is done by two systems: the fire detection system and the fire extinguishing system. The APU Fire Detection Unit (FDU) monitors two detector loops. Each loop has a detector element located in the APU compartment. Warnings are generated according to an AND logic (both loops detect a FIRE). There is one fire bottle located in the aft fuselage for APU FIRE extinguishing.
The APU fire can be extinguished manually or automatically.
The APU fire protection system gives aural and visual indications for FIRE and FAULT conditions. In case of a FIRE when the A/C is on the ground, the Automatic Fire Extinguishing Control Unit (AFECU) initiates an auto shutdown of the APU and discharges the extinguishing bottle.

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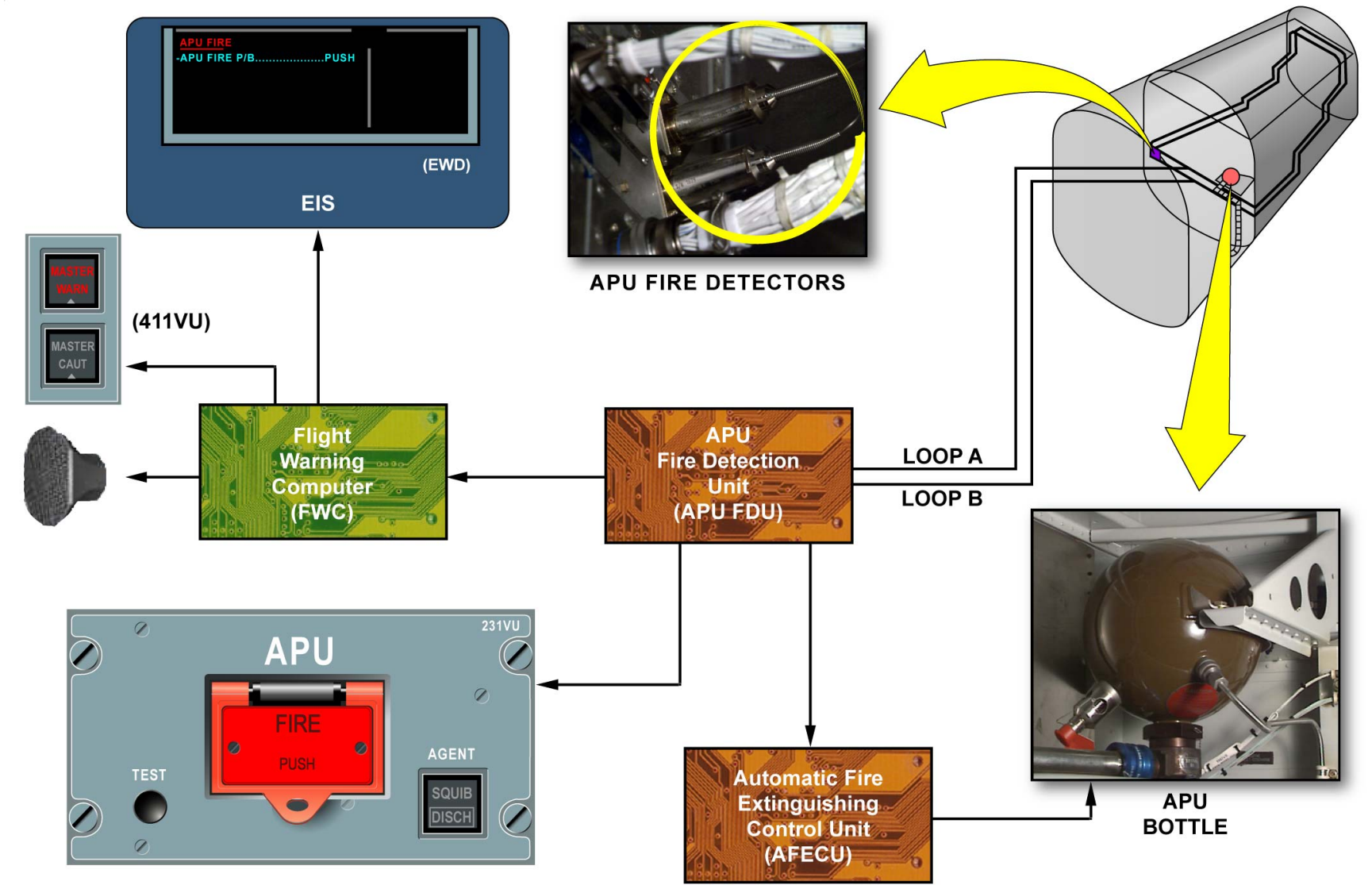

SYSTEM OVERVIEW - APU FIRE PROTECTION

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FIRE PROTECTION LINE MAINTENANCE BRIEFING (2)

SYSTEM OVERVIEW (continued)

AVIONICS COMPARTMENT SMOKE DETECTION

The avionics compartment smoke detection is done by two smoke detectors installed on the air extraction duct of the ventilation system. The detectors send signals via a dual loop to the Smoke Detection Control Unit (SDCU). The SDCU gives aural and visual indications in SMOKE and FAULT conditions.

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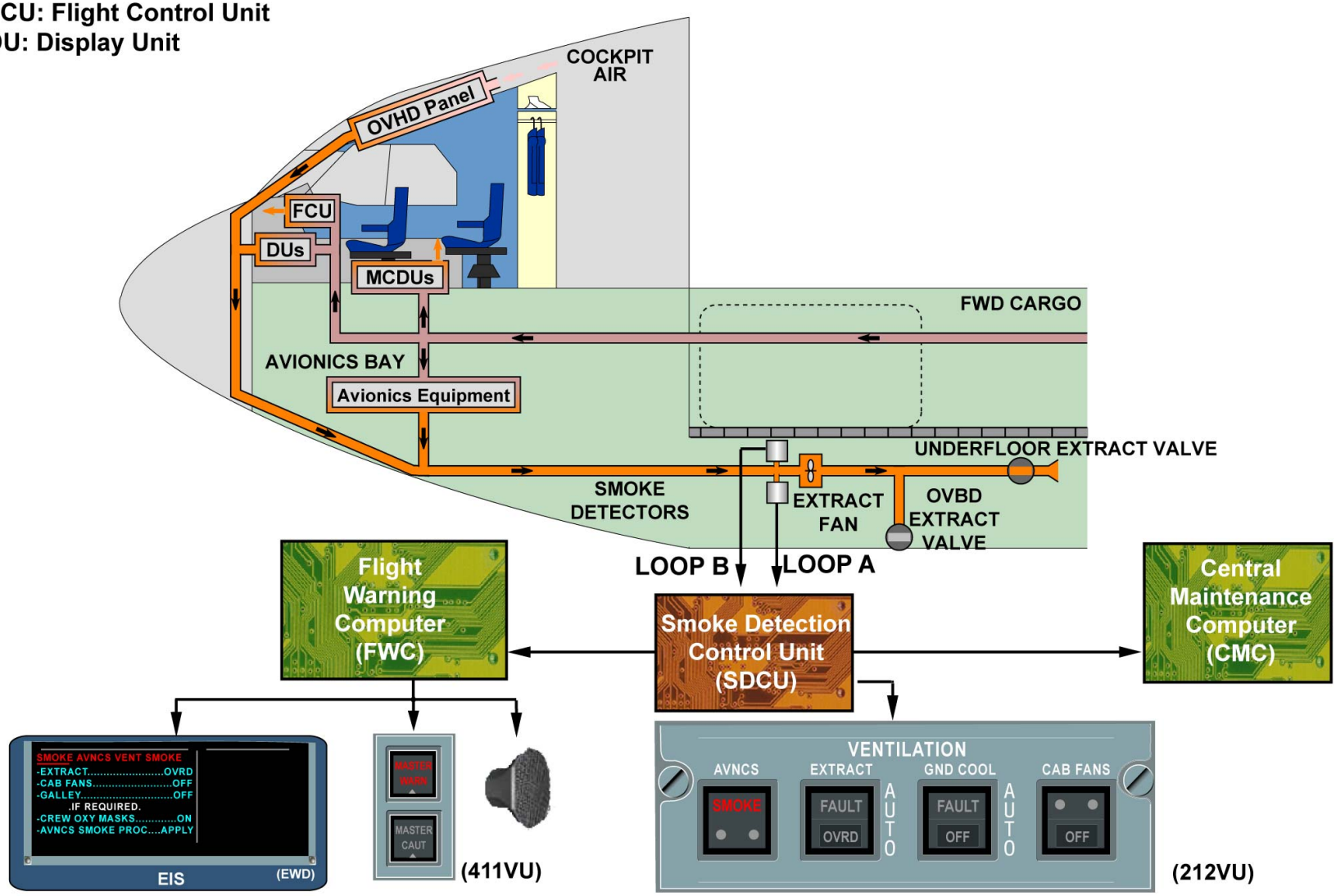
OVHD Panel: Overhead Panel
FCU: Flight Control Unit
DU: Display Unit



SYSTEM OVERVIEW - AVIONICS COMPARTMENT SMOKE DETECTION

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FIRE PROTECTION LINE MAINTENANCE BRIEFING (2)

SYSTEM OVERVIEW (continued)

CARGO COMPARTMENTS SMOKE PROTECTION

Each cargo compartment has cavities:
- 2 cavities in the FWD cargo compartment,
- 2 cavities in the AFT cargo compartment,
- 1 cavity in the BULK cargo compartment.

Each cavity holds 2 smoke detectors and a fire-extinguishing nozzle.
The cargo compartments smoke protection is done by two systems: the cargo smoke detection system and the cargo fire extinguishing system. The Smoke detectors are optical type. The smoke detectors are connected to the SCDU via loop A and loop B.
When the SDCU confirms smoke detection, it triggers warnings in the cockpit:
- a Continuous Repetitive Chime (CRC), a MASTER WARNing and an EWD fault message through the Flight Warning Computer (FWC).
- on the CARGO SMOKE control panel.

When smoke is detected, isolation valves optionally installed in the affected compartment will automatically close and the extraction fan will stop.
Two fire extinguisher bottles located in the forward cargo compartment are also used for fire extinguishing in the Lower Deck Cargo Compartments (LDCCs). Each bottle has two discharge heads, one dedicated for the forward cargo compartment and one for the AFT/BULK cargo compartment. The extinguishing agent flows through rigid pipes and is discharged through the extinguisher nozzles in the forward, aft or bulk compartment.
The fire extinguisher bottles are discharged from the cockpit by the CARGO SMOKE panel AGENT pushbuttons.

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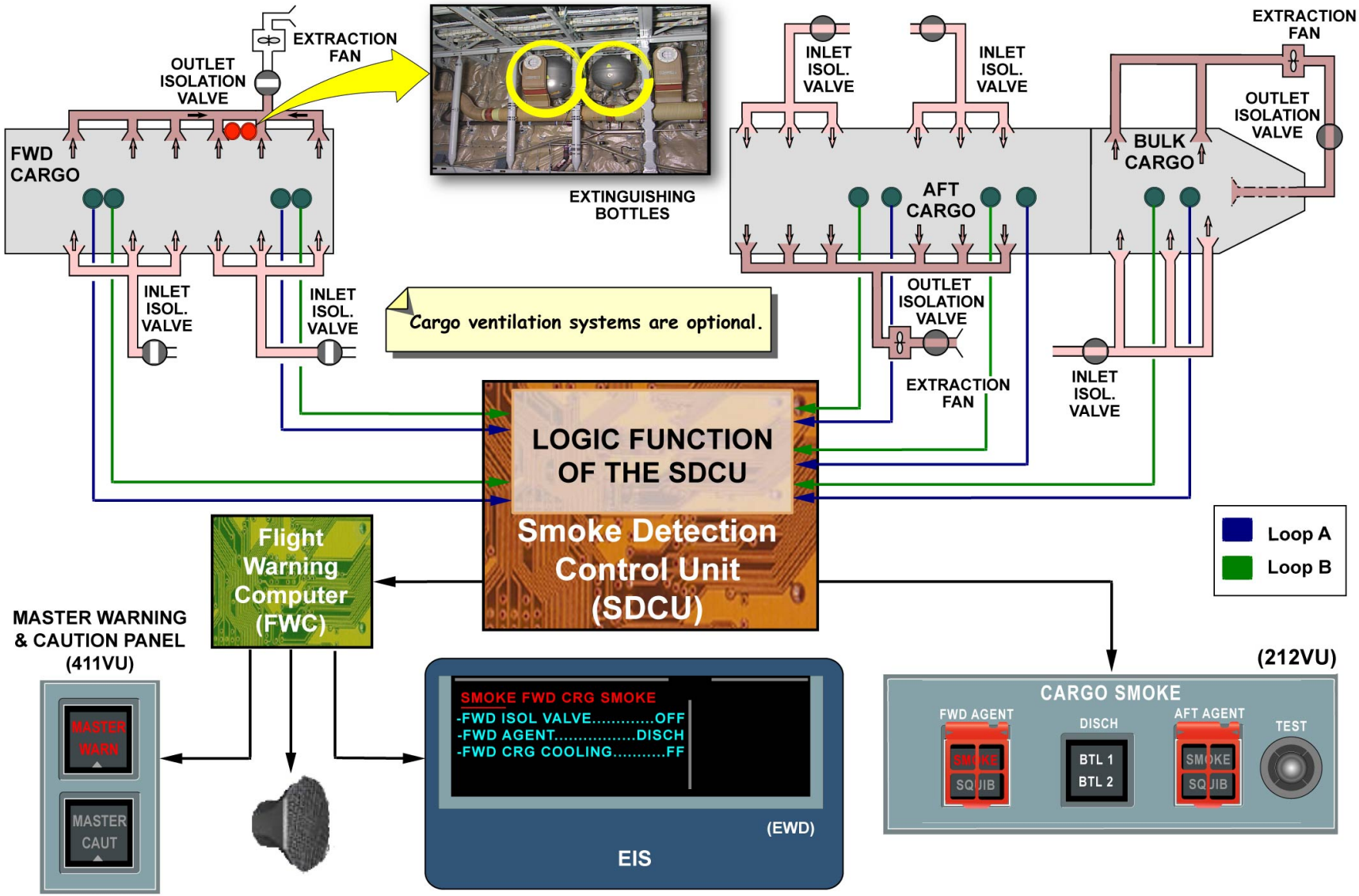

SYSTEM OVERVIEW - CARGO COMPARTMENTS SMOKE PROTECTION

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FIRE PROTECTION LINE MAINTENANCE BRIEFING (2)

SYSTEM OVERVIEW (continued)

LAVATORY SMOKE DETECTION AND FIRE EXTINGUISHING

The lavatory smoke detection system and the waste bin fire extinguishing system fulfill the lavatory fire protection. The system is monitored by the SDCU, which sends signals to the FWC, and to the Cabin Intercommunication and Data System (CIDS). The SDCU, the FWC, and the CIDS give aural and visual warning indications in the cockpit and in the cabin in SMOKE and FAULT conditions.
Each lavatory has a single smoke detector located in the air extraction duct in the lavatory ceiling. A fire extinguisher bottle is installed above the waste bin in each lavatory. If a fire starts in the waste bin the fire extinguisher discharges automatically. Portable fire extinguishers are located throughout the cabin and cockpit.

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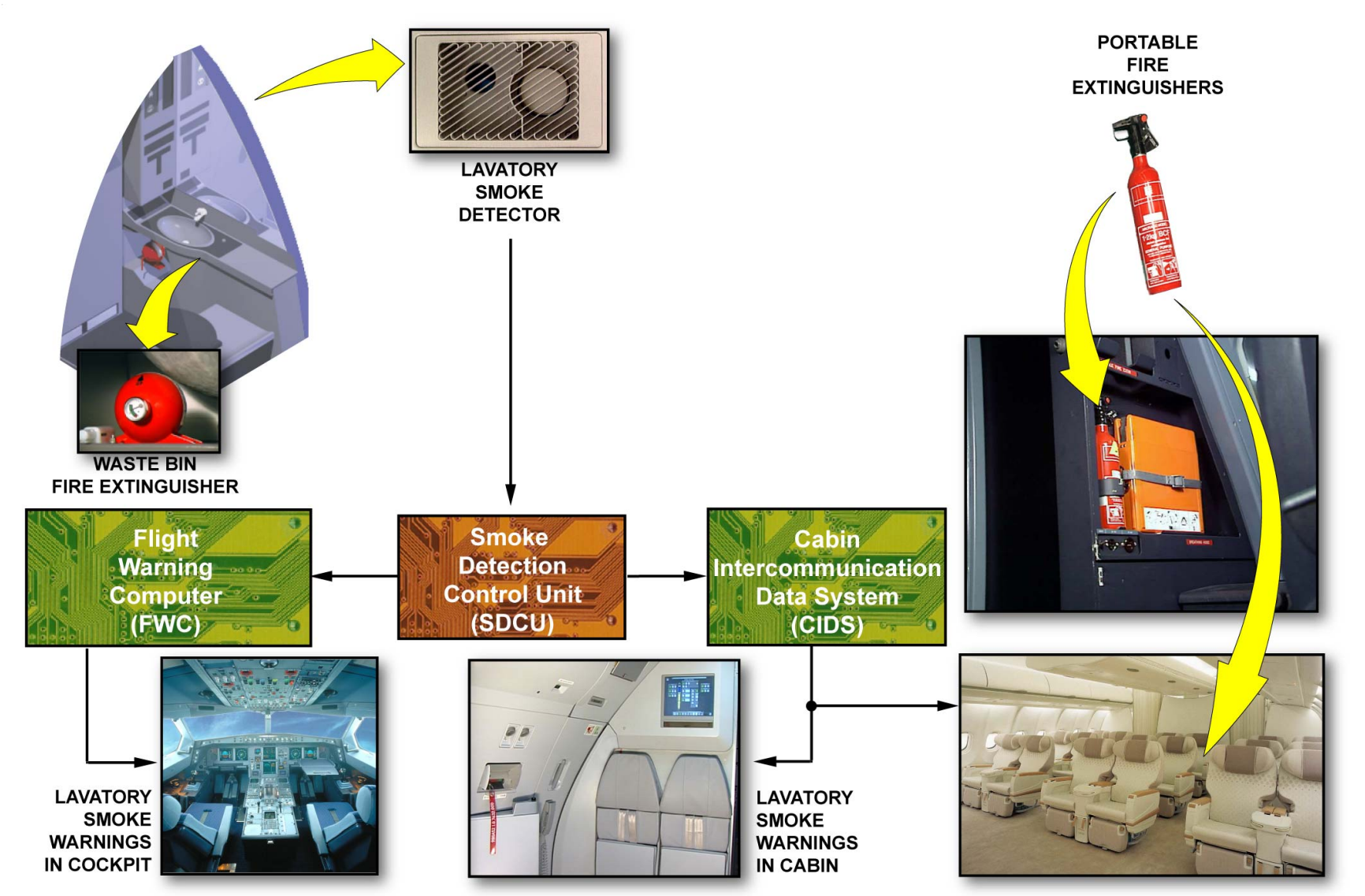

SYSTEM OVERVIEW - LAVATORY SMOKE DETECTION AND FIRE EXTINGUISHING

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FIRE PROTECTION LINE MAINTENANCE BRIEFING (2)

DAILY CHECKS

The ENGINE and APU FIRE tests must be done prior to start.
Press and hold the TEST pushbutton on the ENGine or APU fire panel.
The test will trigger all of the FIRE warnings in the cockpit.
During the engine fire test:
- ENG FIRE lights on the overhead panel come on,
- FIRE lights on the ENGINE START panel come on,
- both SQUIB lights come on for each engine,
- both DISCHarge lights come on for each engine,
- both red MASTER WARNing lights come on, on the glare shield panel,
- CRC sounds,
- engine FIRE procedure displayed on the upper ECAM DU,
- ENGINE page displayed on the lower ECAM DU.

During the APU fire test:
- FIRE light on the overhead panel comes on,
- SQUIB light comes on,
- DISCH light comes on,
- both red MASTER WARN lights come on, on the glare shield panel,
- continuous chime sounds,
- APU FIRE procedure is displayed on the upper ECAM DU,
- APU page is displayed on the lower ECAM DU.

The APU fire bottle is located forward of the APU firewall. Prior to starting the APU, the bottle pressure may be checked by means of the red disk located on the rear fuselage on the lower left hand side. The red disk is connected to an overpressure discharge tube. If the bottle pressure becomes excessive, the bottle will discharge to protect the structure and the red disk will blow out.
The cargo compartments should be checked for integrity. Any damage to the cargo compartment ceiling or sidewall liner should be repaired immediately. If the compartment is ventilated, the ventilation isolation valves are automatically closed when smoke is detected. A hole in the liner could induce airflow through the compartment, compromising the fire protection of the compartments. If the compartment is not ventilated, no airflow is permitted.

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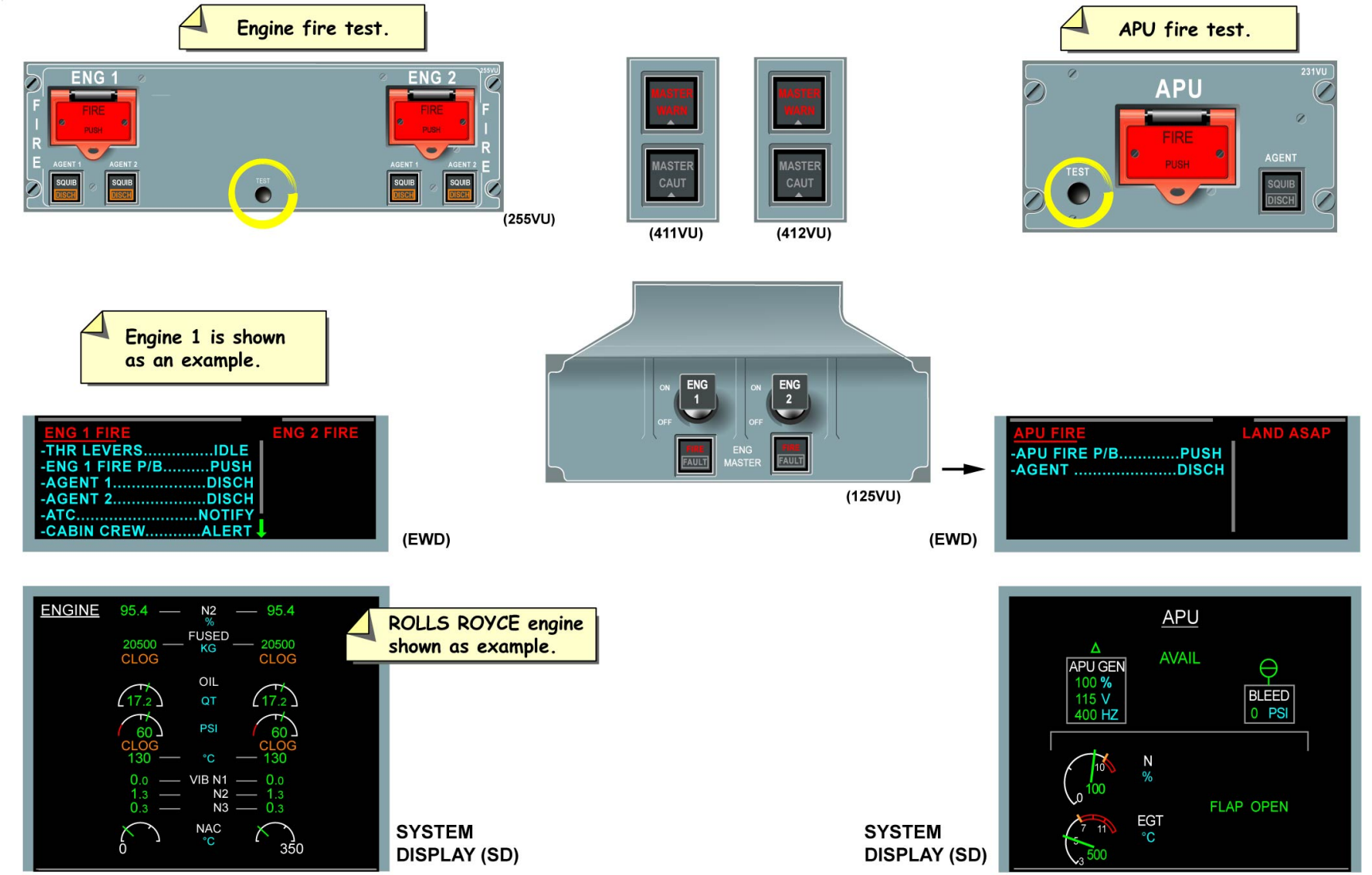

DAILY CHECKS

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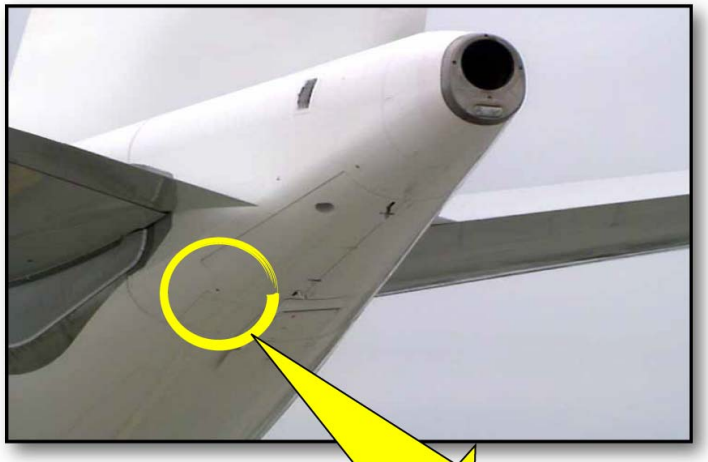
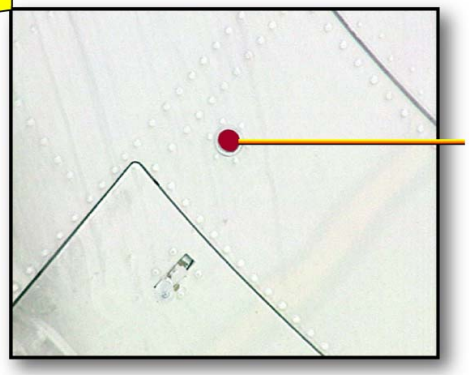
Check red disc on walk-around.



Check cargo compartment sidewall integrity.



APU FIRE BOTTLE
DISCHARGE INDICATOR

DAILY CHECKS

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FIRE PROTECTION LINE MAINTENANCE BRIEFING (2)

MEL/DEACTIVATION

Dispatch procedures

LAVATORY SMOKE DETECTION

Each lavatory has a single detector. If this detector fails, the aircraft may be dispatched with the lavatory locked closed and the waste bin empty. Periodic smoke checks should also be done by the cabin staff. To lock the lavatory, lift the "LAVATORY" cover plate on the outside of the door and slide the unlocking pin to the LOCK position.

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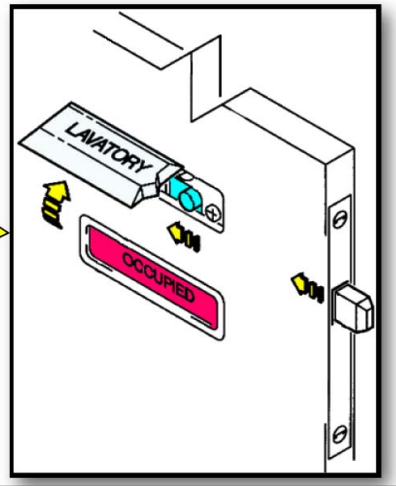

MEL

R R R R R R R R R R	17-01 Lavatory Smoke Detection System	B	-	-	(o) (m) a) One or more may be inoperative provided: 1) The associated lavatory fire extinguishing system is checked operative before each flight, and 2) Absence of smoke in the associated lavatory is checked every 15 minutes. -or- (o) b) One or more may be inoperative provided: 1) The associated lavatory waste receptacle is empty, and 2) The associated lavatory door is locked closed and placarded inoperative, and. 3) The lavatory is not used for any purpose, and 4) A procedure is used to check periodically absence of smoke in associated lavatory.
		C	-	-	

MEL/DEACTIVATION - LAVATORY SMOKE DETECTION

FIRE PROTECTION LINE MAINTENANCE BRIEFING (2)

MEL/DEACTIVATION (continued)

APU FIRE EXTINGUISHER OVERPRESSURE INDICATION (RED DISK) MISSING

The aircraft may be dispatched as per the MEL with the APU fire extinguisher bottle overpressure indication missing. The conditions for dispatch include testing the SQUIB integrity and checking the extinguisher bottle pressure switch before the first flight of the day.
The following procedure is:
- do the APU FIRE test,
- get access to the APU extinguisher bottle and make sure that communications with the cockpit is established,
- insert a 3/32" Allen-key into the pressure switch test socket and turn,
- in the cockpit, the DISCH light comes on, on the APU AGENT pushbutton on the APU FIRE panel,
- close up.

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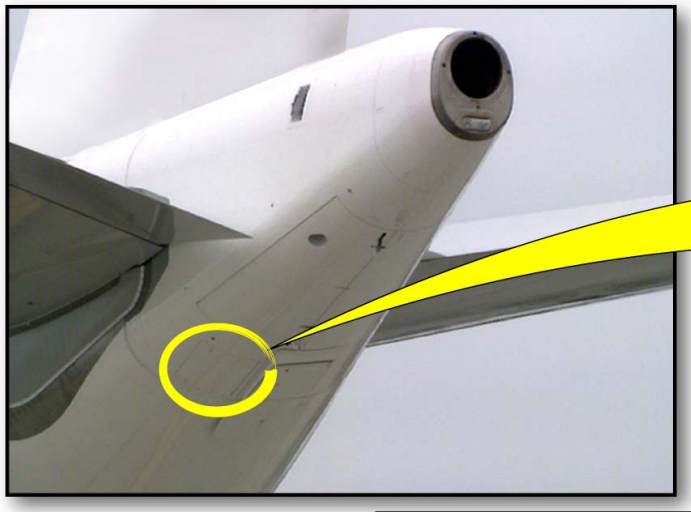
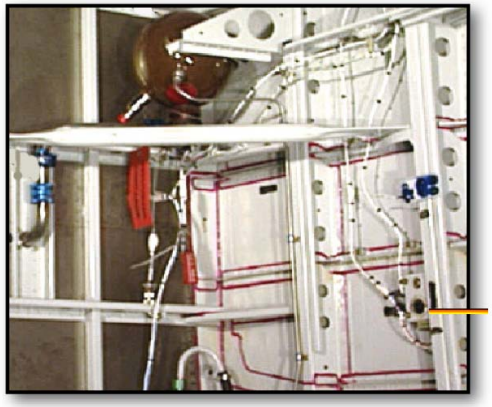


MEL

21-04	APU fire extinguisher Overpressure indication (Red Disk)	C	1	0	(m) May be inoperative provided: (1) The squib test is used to check the squib integrity, and (2) The bottle pressure switch is checked operative before the first flight of each day.



MEL/DEACTIVATION - APU FIRE EXTINGUISHER OVERPRESSURE INDICATION (RED DISK) MISSING

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FIRE PROTECTION LINE MAINTENANCE BRIEFING (2)

MAINTENANCE TIPS

If an APU fire is detected when the aircraft is on the ground, the AFECU operates the APU fire extinguishing system automatically. The AFECU can be tested on ground via the MCDU. However this test must be performed while the APU is NOT running, otherwise this test will lead to APU emergency shutdown, without fire extinguisher discharge. This test is initiated by selecting the System Report/Test/FIRE PROT, ENG/APU menu and then selecting the APU AFE/TEST key.
One squib of each engine fire bottle and one squib of the APU fire bottle are supplied by 28V DC from a HOT bus. When doing maintenance task with the FIRE P/B released out, make sure to pull all squib C/Bs (4 for the Engine / 2 for the APU) to protect against accidental extinguisher bottle discharge. If the C/Bs are not pulled, the engine or APU fire bottle may be discharged even without power on the aircraft.
When you push the TEST P/B on the CARGO SMOKE panel for approximately 2 s, the SDCU starts a test of the smoke detectors installed in the cargo and avionic compartments. It is highly recommended to launch this PTT test only after the SDCU power-up test has been completed in order to avoid the interruption of the test or a failure of this test. Therefore, wait at least 4 minutes after SDCU power-up before doing any PTT test on the CARGO SMOKE panel.

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	ELECTRICAL SUPPLY	SEQ 001	REV 15

BUS EQUIPMENT LIST

R

			NORM			EMER ELEC		
			AC	DC	DC BAT	AC ESS	DC ESS	HOT
ENG/APU	FIRE DETECTION	ENG LOOP A					X	
		ENG LOOP B		DC2				
		APU LOOP A					X	
		APU LOOP B			X			
	FIRE EXTINGUISHING	ENGINES						
		BTL 1 SQUIB A						HOT 2
		BTL 1 SQUIB B		DC 2				
		BTL 2 SQUIB A						HOT 1
		BTL 2 SQUIB B		DC 2				
		APU						
		BTL SQUIB A						HOT 1
		BTL SQUIB B			X			
		APU AUTO EXT						HOT 2
CARGO LAV AVIONICS	SDCU 1						SHED	
	SDCU 2			DC 2				
	CARGO SQUIB A							HOT 1
	CARGO SQUIB B			DC 2				
LDMCRC ◁	SMOKE DETECTION	SDCU 1					SHED	
		SDCU 2		DC 2			SHED	
	FIRE EXTINGUISHING			DC 2				
FCRC ◁	SMOKE DETECTION	SDCU 1					SHED	
		SDCU 2		DC 2				

MAINTENANCE TIPS

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ENGINE FIRE PROTECTION D/O (3)

ENGINE FIRE PROTECTION DESCRIPTION

DETECTORS

The fire detectors are installed in pair on pre-formed, stainless steel supports on the engine. The fire detection system is of the electro-pneumatic type.

Each fire detector is made up of a sensing element, and a responder assembly. The detector is pneumatically operated by heating its sensing element, which contains helium gas and a hydrogen-charged titanium core material. The sensing element reacts according to the ideal gas law. One end of the sensing element is hermetically soldered and the other one is connected to a stainless steel body called responder. This body contains a chamber connected to two pressure switches: an ALARM switch and a MONITOR switch (or INTEGRITY switch).

In normal state, the MONITOR switch is closed and the ALARM switch is open.

In alarm state: the effect of an average temperature expands the inert gas (helium) which in turn closes the ALARM switch, or the effect of heat caused by impinging flame or hot gas, releases active gas from the hybrid core which in turn closes the ALARM switch. In both cases the detector sends a fire signal.

In fault state: in the event of gas pressure loss (pipe fracture or cut off due to a torching flame), the INTEGRITY switch opens and generates a fault signal.

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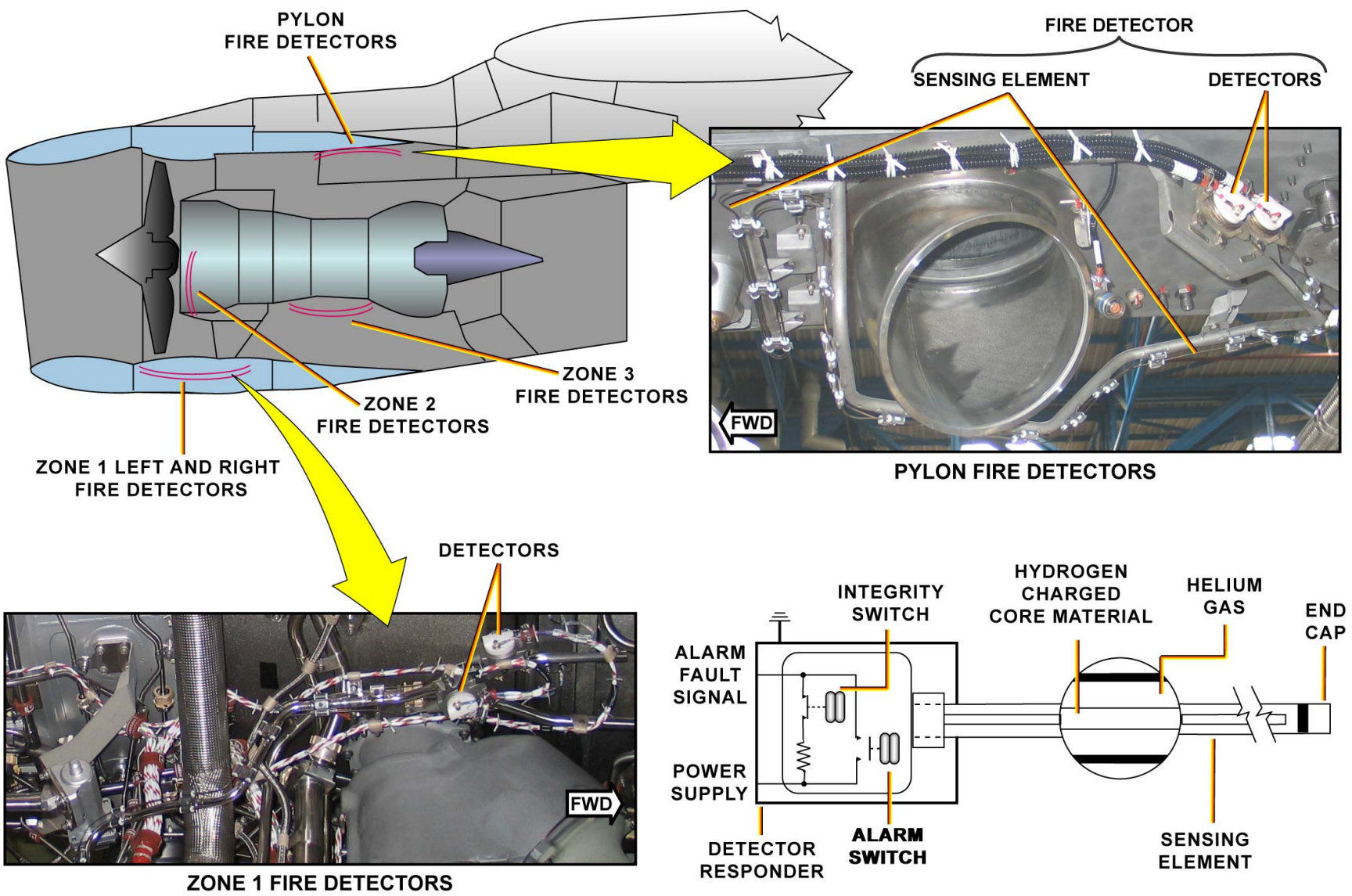

ENGINE FIRE PROTECTION DESCRIPTION - DETECTORS

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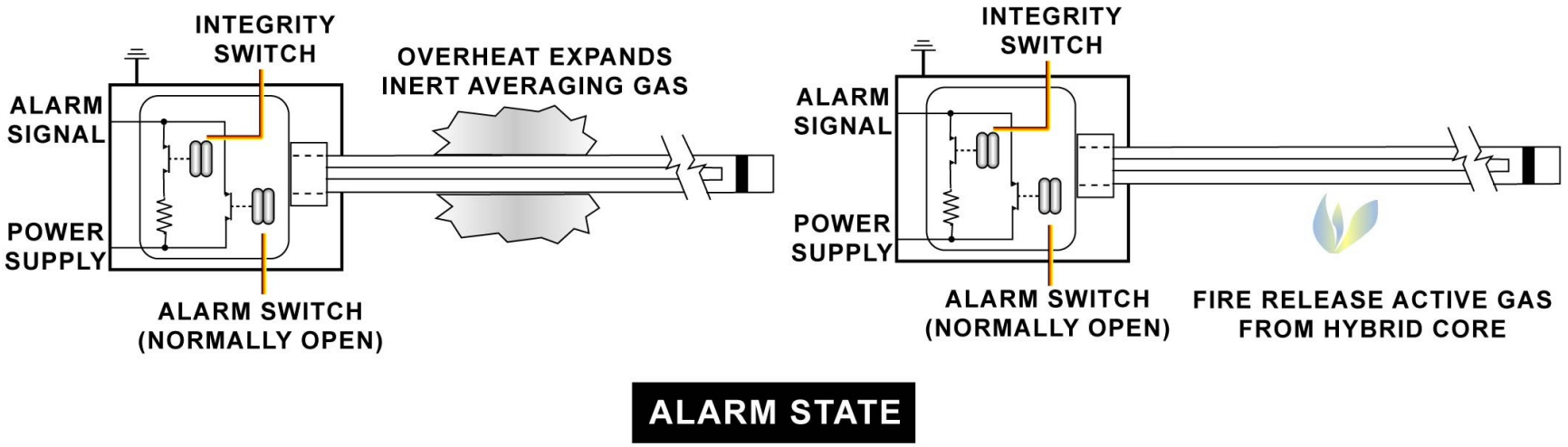

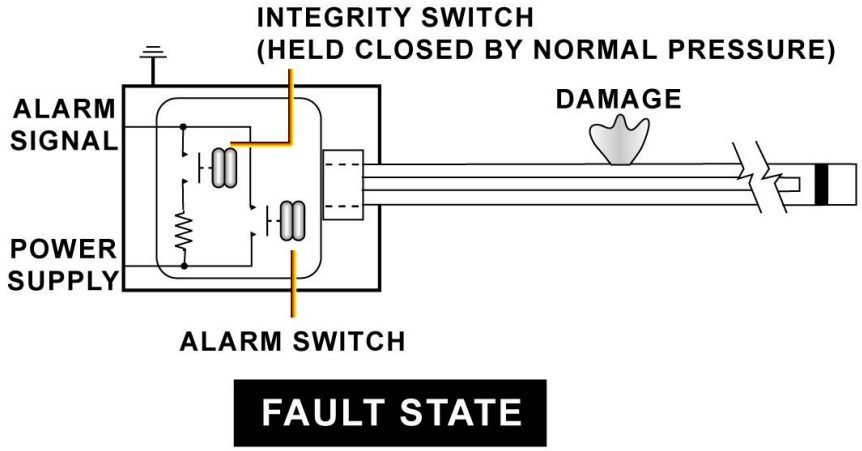

ENGINE FIRE PROTECTION DESCRIPTION - DETECTORS

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ENGINE FIRE PROTECTION D/O (3)

ENGINE FIRE PROTECTION DESCRIPTION (continued)

LOOPS

The fire detectors are installed in pairs (loop A/loop B). Each fire detection loop comprises the five fire detectors connected in parallel. On each engine, there are two continuous loops for fire detection. The loops are connected in parallel to the Fire Detection Unit (FDU). Each fire detection loop is connected to a separate channel of the FDU and processes signals from the detectors.
The connection is made through an AND logic to avoid spurious fire warnings. In case of failure of one loop, the AND logic becomes an OR logic. The A/C can be released in this configuration.

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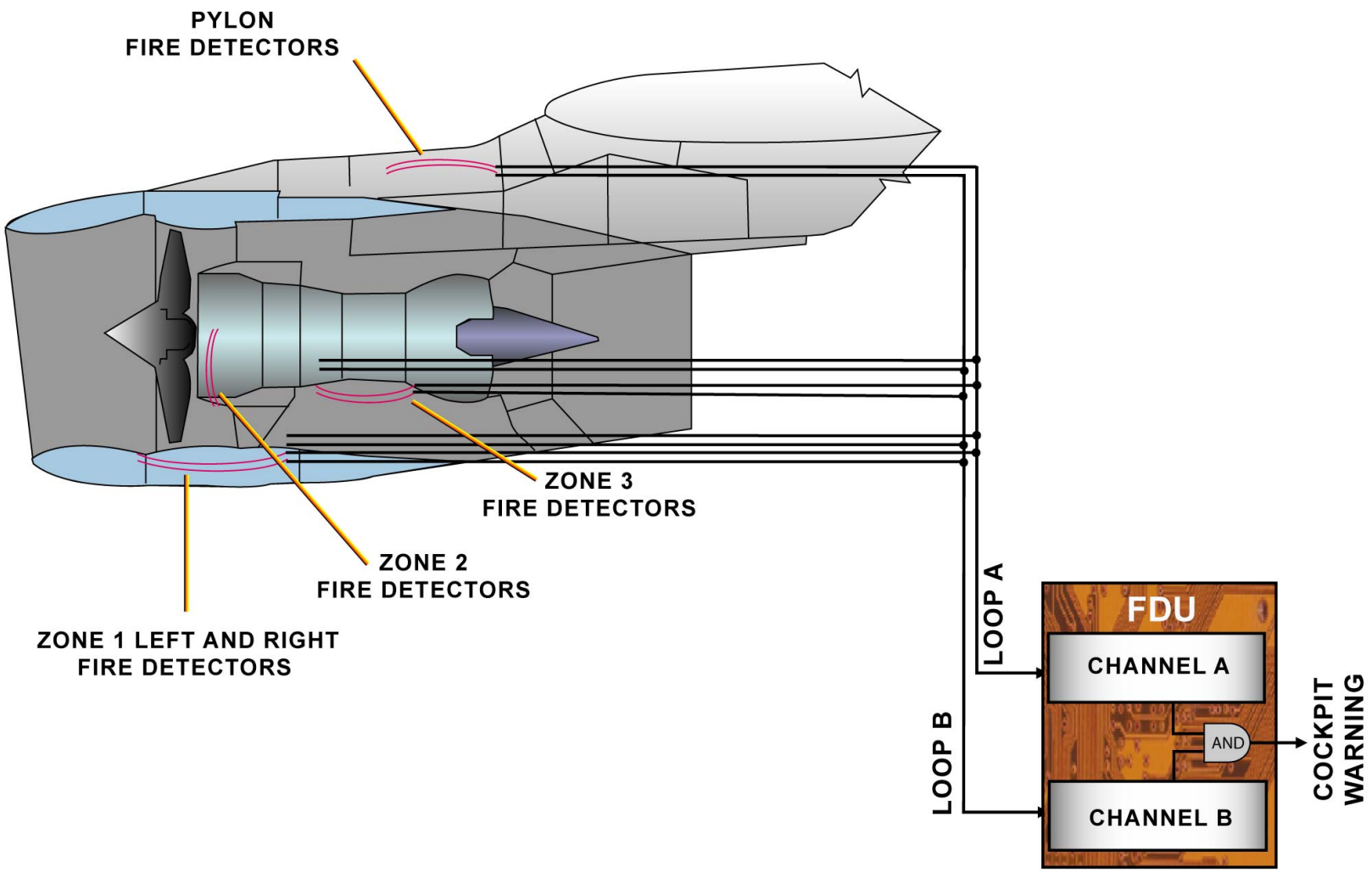

ENGINE FIRE PROTECTION DESCRIPTION - LOOPS

ENGINE FIRE PROTECTION D/O (3)

ENGINE FIRE PROTECTION DESCRIPTION (continued)

BOTTLE

The distribution system for each engine includes two fire extinguisher bottles, pipes and nozzles. The fire extinguishing distribution system is routed from the fire extinguisher bottles located in each engine pylon to the zone 1 (accessory compartment), zone 2 (FWD compressor compartment), zone 3 (core compartment).
The fire extinguisher bottle is of the high-rate discharge type and is made up of:
- a spherical container which contains an extinguishing agent (Halon 1301),
- a discharge head,
- a cartridge.

On the spherical container there are a pressure switch, a filling fitting and two outlet ports and frangible discs.
The pressure switch monitors the fire extinguisher bottle (discharge or leakage). It is electrically connected to the FDU which generates a discharge signal to the DISCH legend on the ENGine/FIRE control panel. The pressure switch installed on the fire extinguisher bottle can be tested manually.
The filling fitting assemblies are used to fill the fire extinguisher bottle.
The frangible disc installed on the outlet port is ruptured when the cartridge is fired. The fire extinguishing agent is then discharged via the discharge head in the fire extinguishing distribution system. A strainer retains the fragments from the diaphragm. The frangible disc also operates as an overpressure device in case of excessive pressure in the fire extinguisher bottle.
The cartridge is installed on the discharge head and contains explosive powder. The powder is fired by two filaments supplied with 28 VDC. Each filament is connected to a ground wire and can supply the electrical power necessary for the firing, if the other filament fails.

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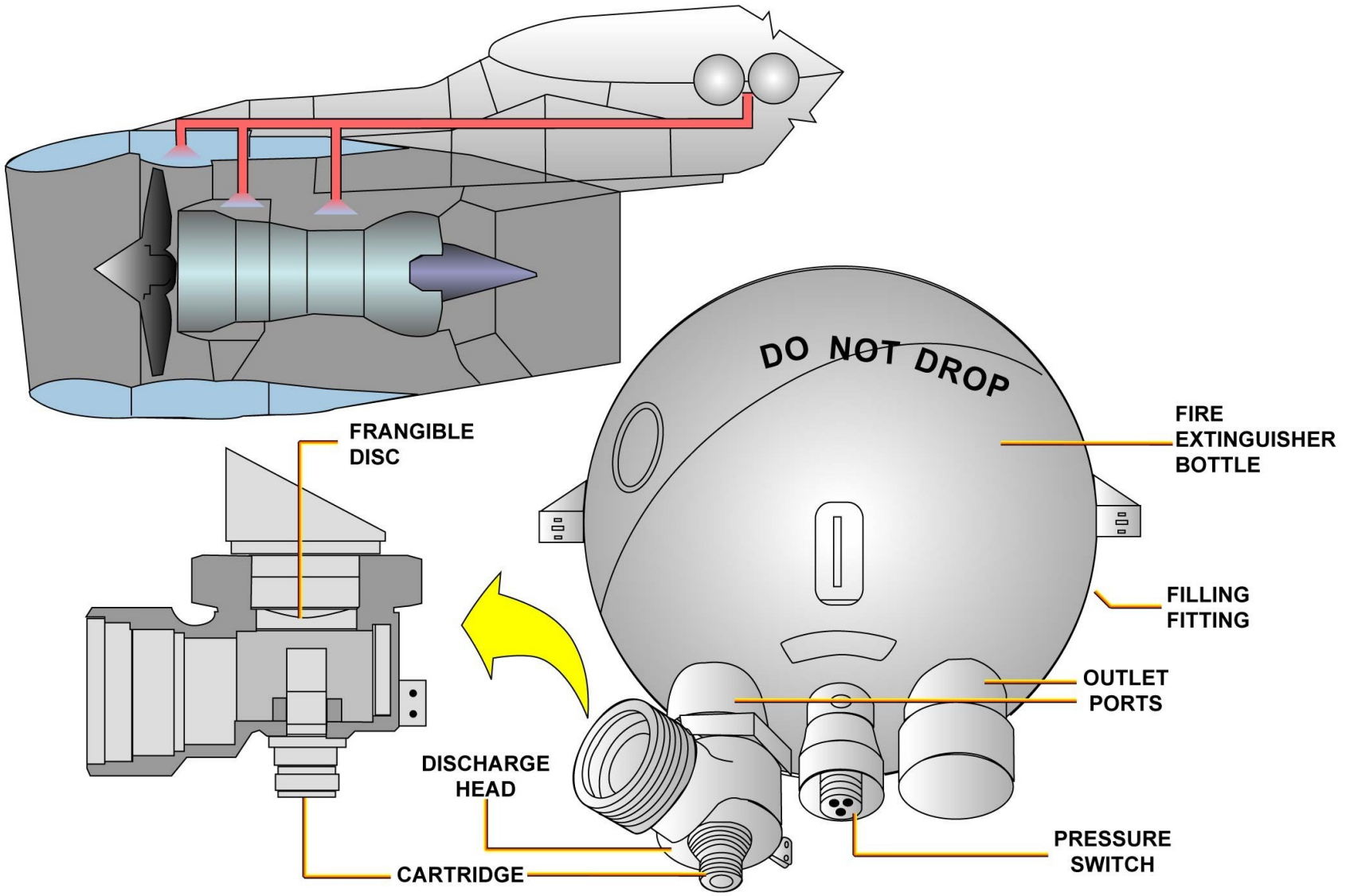

ENGINE FIRE PROTECTION DESCRIPTION - BOTTLE

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ENGINE FIRE PROTECTION D/O (3)

ENGINE FIRE PROTECTION DESCRIPTION (continued)

FDU (FIRE DETECTION UNIT)

The FDU processes the signals generated by the responder of the detectors. The FDU has three functional modules:
- two independent channels which have their own power supply (1 channel for each detection loop),
- one monitoring microcontroller circuitry (for maintenance purpose only).

The two channels, A and B, normally operate together, with an AND logic. The two channels are identical and, if one loop is inoperative, each one can operate independently. The input signals of each channel are a variable loop resistance made of the five detectors in parallel and a reference voltage. The equivalent resistance varies when a change of state occurs in the monitored areas of the engine. The reference voltage is sent to an FDU logic. This FDU logic is sent to the FIRE and FAULT logic gate. These logic gates generate the alarm outputs. The output signals are generated via discrete signals and/or the ARINC 429 bus.

After the analysis of the input signals, the FDU logic outputs determine a FIRE or a FAULT state of the circuitry. A FAULT state of the circuitry can be due to an unserviceable detector (opening of a MONITOR switch or loss of the electrical signal) or if the responder or the connectors of the FDU is contaminated. A FAULT state of the circuitry generates a LOOP A(B) INOP signal. A FIRE state of the circuitry can be due to a detection of a fire by one of the responders.

There is a FIRE warning signal if any of the following conditions are met:
- FIRE A and FIRE B,
- FIRE A and FAULT B,
- FAULT A and FIRE B,
- FAULT A and FAULT B in less than 5 seconds.

The FIRE warning signals, thus generated, are transmitted to the cockpit, at the following locations:
- ENGine/FIRE control panel: ENGine/FIRE P/BSW,
- ENGine MASTER control panel: ENGine/FIRE/FAULT annunciator,
- MASTER WARNing light
- EWD,
- SD,
- Continuous Repetitive Chime (CRC).

There is a FAULT warning signal (INOP signal) if any of the following conditions occurs:
- LOOP A(B) is faulty for more than 20 seconds while the other loop is in normal condition (because of an electrical failure, a failure in a detector or a failure in a detection circuit). The FAULT message, thus generated, is transmitted to the cockpit on the EWD,
- LOOP A and LOOP B are FAULTy, the first one more than 5 seconds before the other one.

The FAULT warning signals thus generated are transmitted to the cockpit, at the following locations:
- MASTER CAUTion light
- EWD,
- Single Chime (SC).

The FAULT message is transmitted continuously via the ARINC 429 bus to the CMC and the FIRE and the FAULT warnings are generated via discrete signals.

The microcontroller operating software:
- monitors the two detection loops,
- isolates the failed detector and loop circuit and memorizes the failures,
- checks the fire test circuitry when it is activated,
- does the self-test at the power-up of the FDU,
- does the built-in test and transmits the test results on the ARINC 429 bus,

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- continuously transmits a system status message to the CMC via the ARINC 429 bus,
- supplies a serial bus interface and commands and transmits data.

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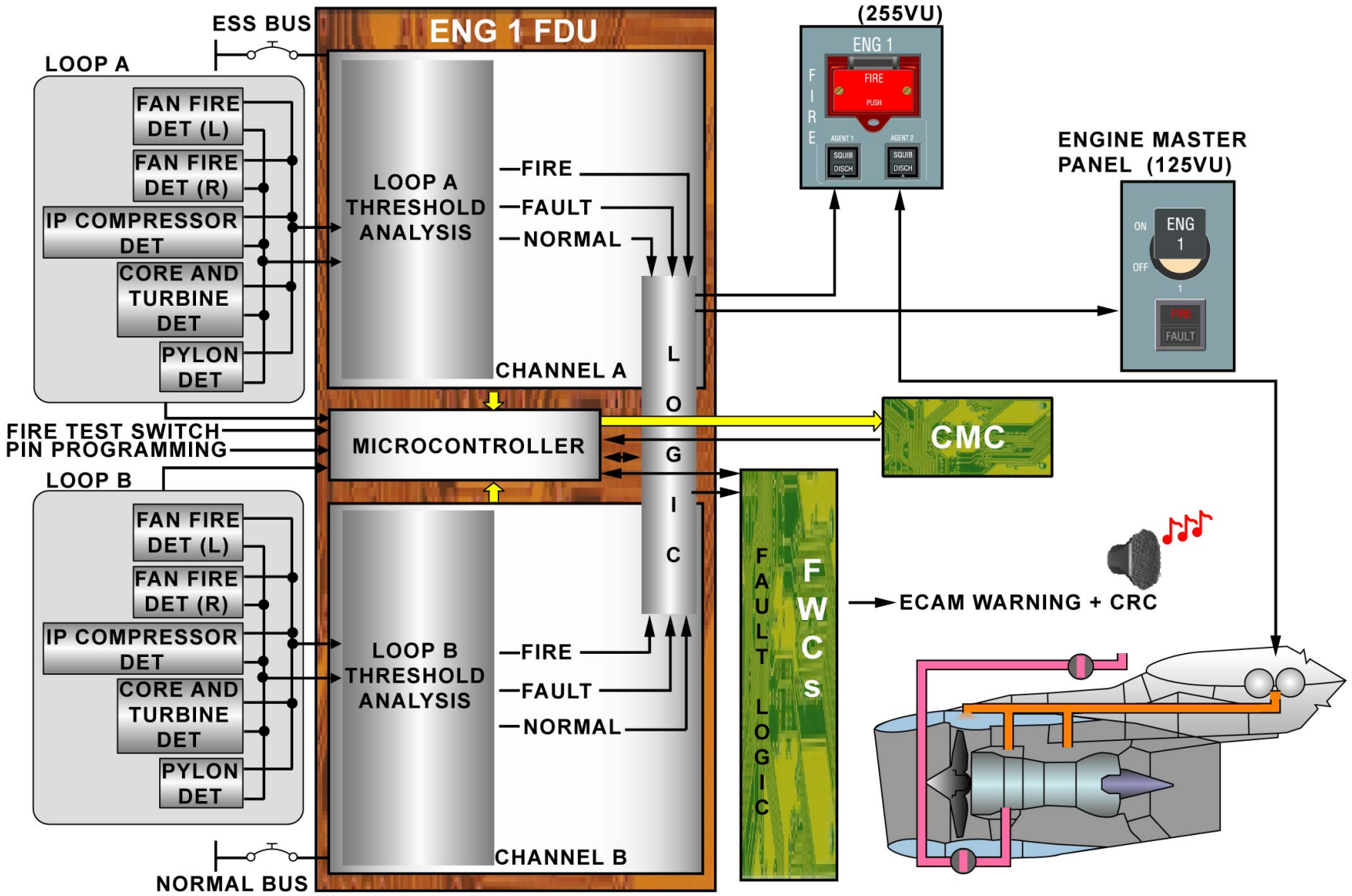

ENGINE FIRE PROTECTION DESCRIPTION - FDU (FIRE DETECTION UNIT)

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ENGINE FIRE PROTECTION D/O (3)

SYSTEM OPERATION IN CASE OF FIRE ON GROUND

When a fire is detected, the continuous repetitive chime sounds, the MASTER WARNing flashes, the ENGINE FIRE PUSHbutton light comes on and the FIRE light on the ENGINE MASTER panel comes on. When the MASTER lever is set to OFF, the LP fuel valve and the High Pressure (HP) fuel valve close and cause engine shutdown.
When the ENGINE FIRE PUSHbutton is released out, the CRC stops and the SC sounds and the MASTER CAUTion comes on due to deactivation of systems. The fuel LP valve closure is confirmed. The SQUIB lights on the AGENT P/Bs come on to indicate that the AGENT P/Bs can be used.
When the AGENT 1 P/B is pressed, fire bottle one is discharged in the engine compartment and the DISCHarge light comes on. The same action with the AGENT 2 P/B must be done.
When the fire is extinguished, the ENGINE FIRE PUSHbutton light and the MASTER WARNing light go off and the FIRE indication on the ENGINE MASTER panel goes off.

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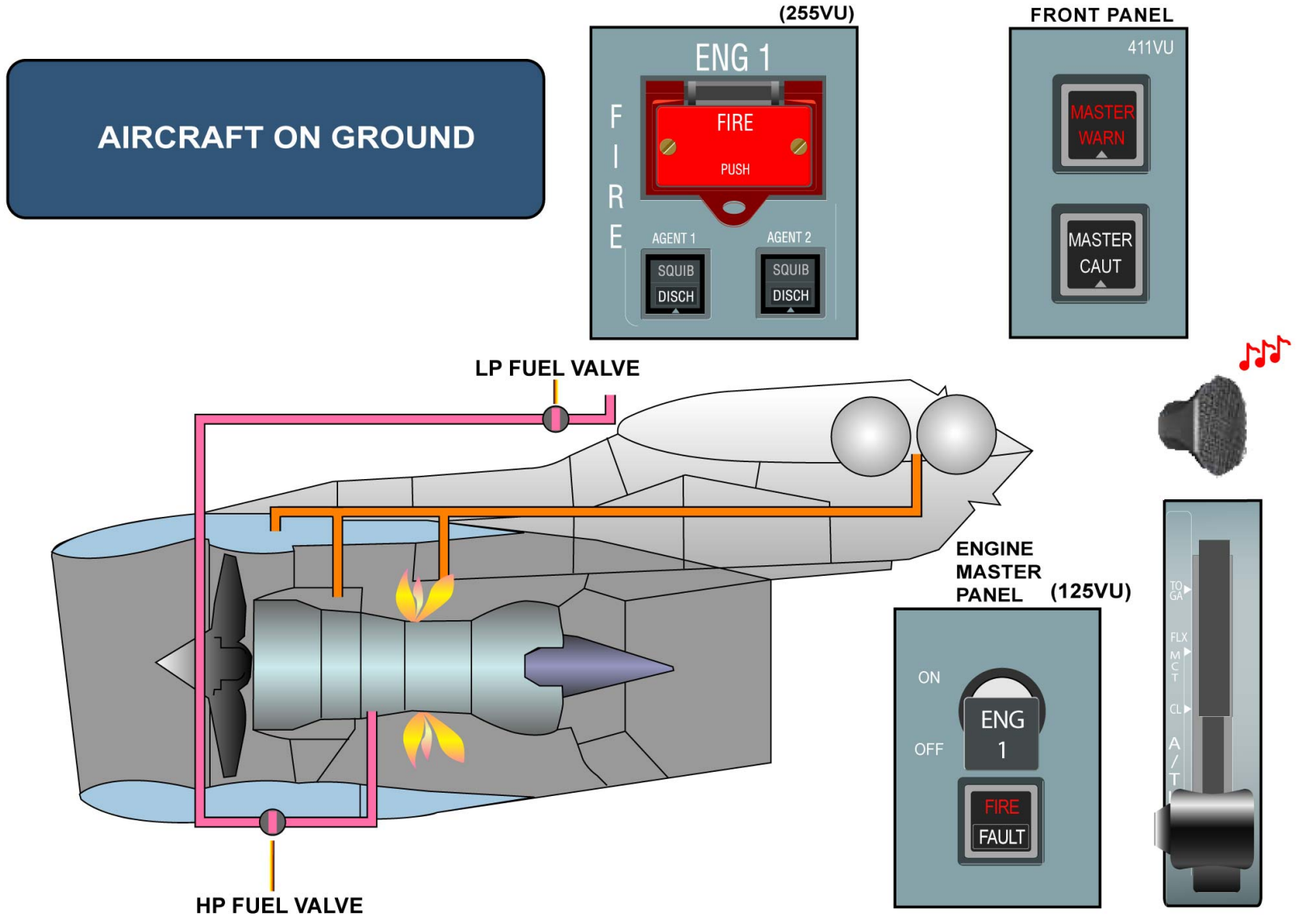
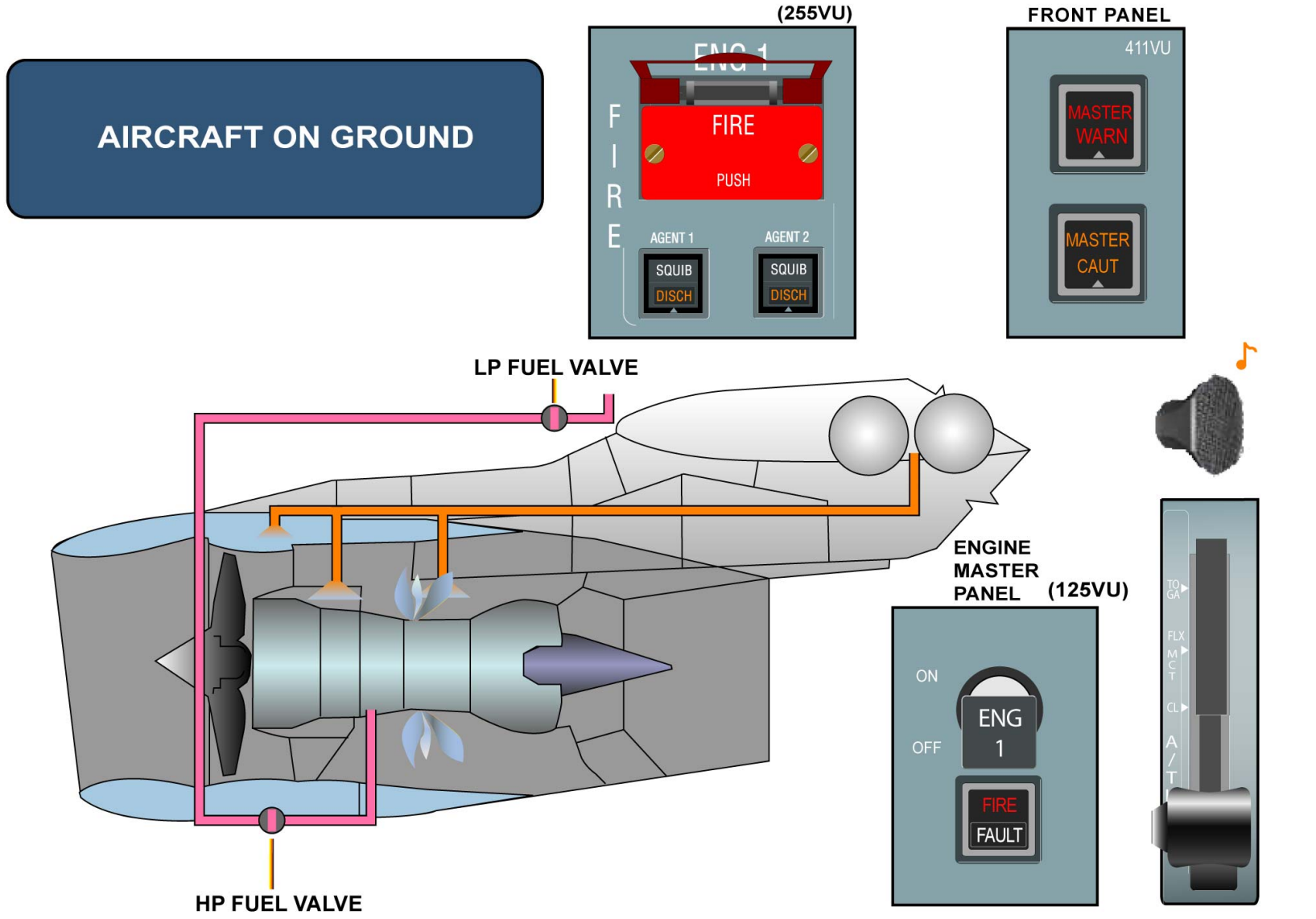
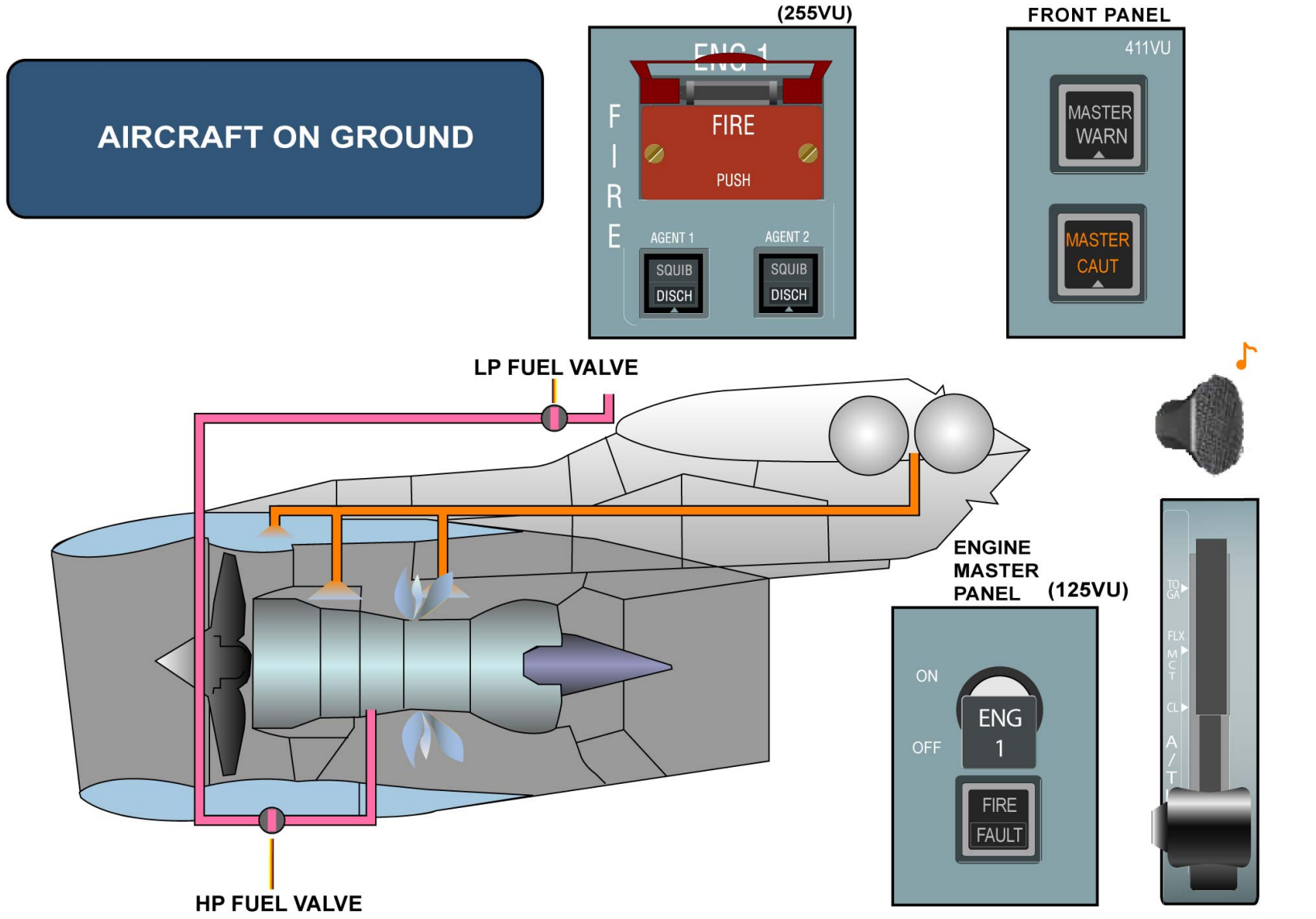


SYSTEM OPERATION IN CASE OF FIRE ON GROUND



SYSTEM OPERATION IN CASE OF FIRE ON GROUND



SYSTEM OPERATION IN CASE OF FIRE ON GROUND

ENGINE FIRE PROTECTION D/O (3)

SYSTEM OPERATION IN CASE OF FIRE IN FLIGHT

When a fire is detected, the CRC sounds, the MASTER WARNing flashes, the ENGINE FIRE PUSHbutton light comes on, and the FIRE light on the ENGINE MASTER panel comes on.
When the ENGINE 1 MASTER lever is set to OFF, the fuel LP and HP valves close and cause engine shutdown.
When the ENGINE FIRE PUSHbutton is released out, the CRC stops, the single chime sounds and the MASTER CAUTion light comes on due to deactivation of systems.
The fuel LP valve closure is confirmed and the SQUIB lights on the AGENT P/Bs come on to indicate that the AGENT P/Bs can be used.
Wait for ten seconds: this is required to reach engine windmilling, reducing the nacelle ventilation which increases the agent effect.
When the AGENT 1 P/B is pressed, the fire bottle 1 is discharged in the engine compartment and the DISCH light comes on. If the fire still persists after 30 seconds, the second bottle must be discharged. When the fire is extinguished the ENGINE FIRE PUSHbutton light, the MASTER WARNing and the FIRE indication on the ENGINE MASTER panel go off.

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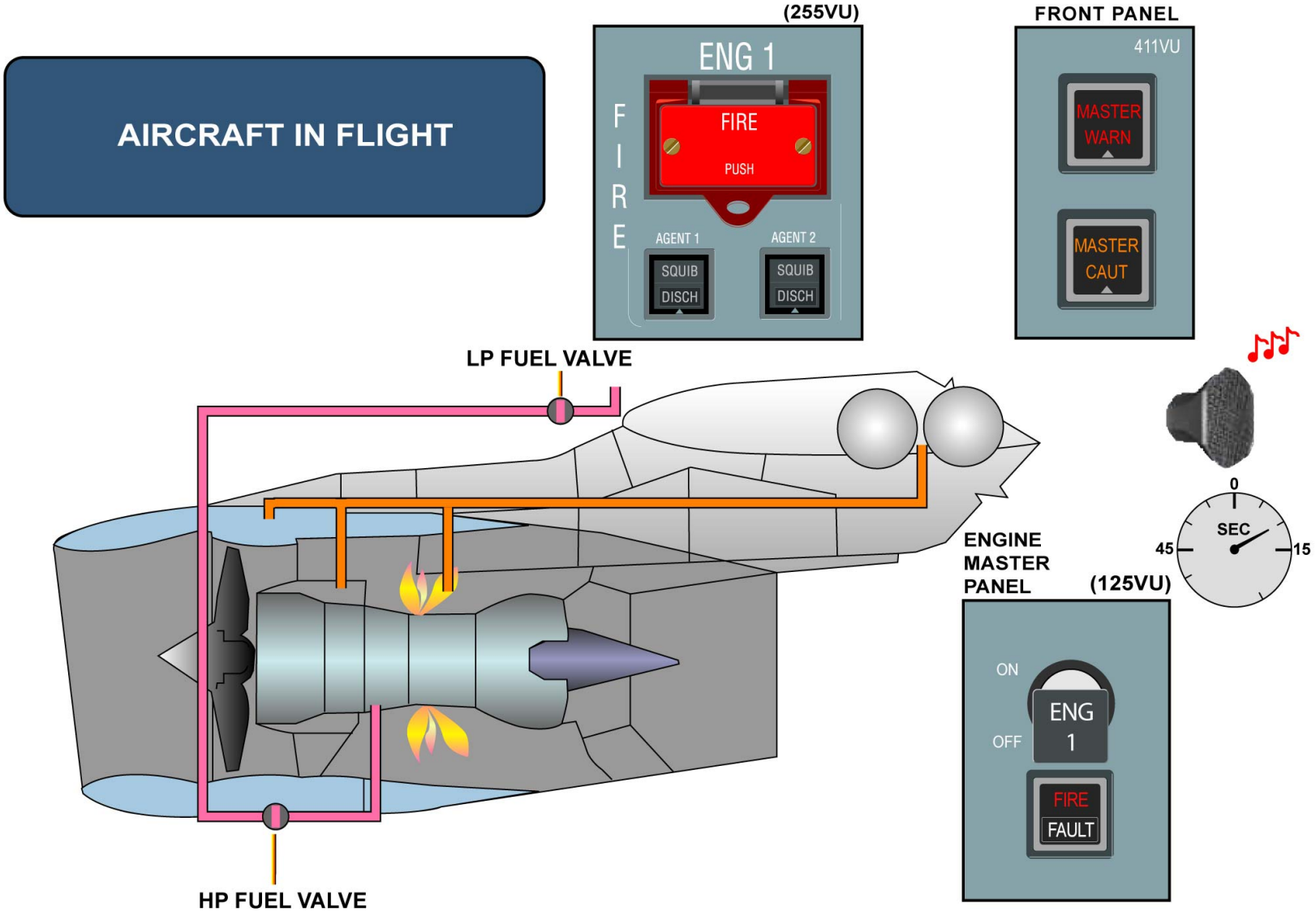

SYSTEM OPERATION IN CASE OF FIRE IN FLIGHT

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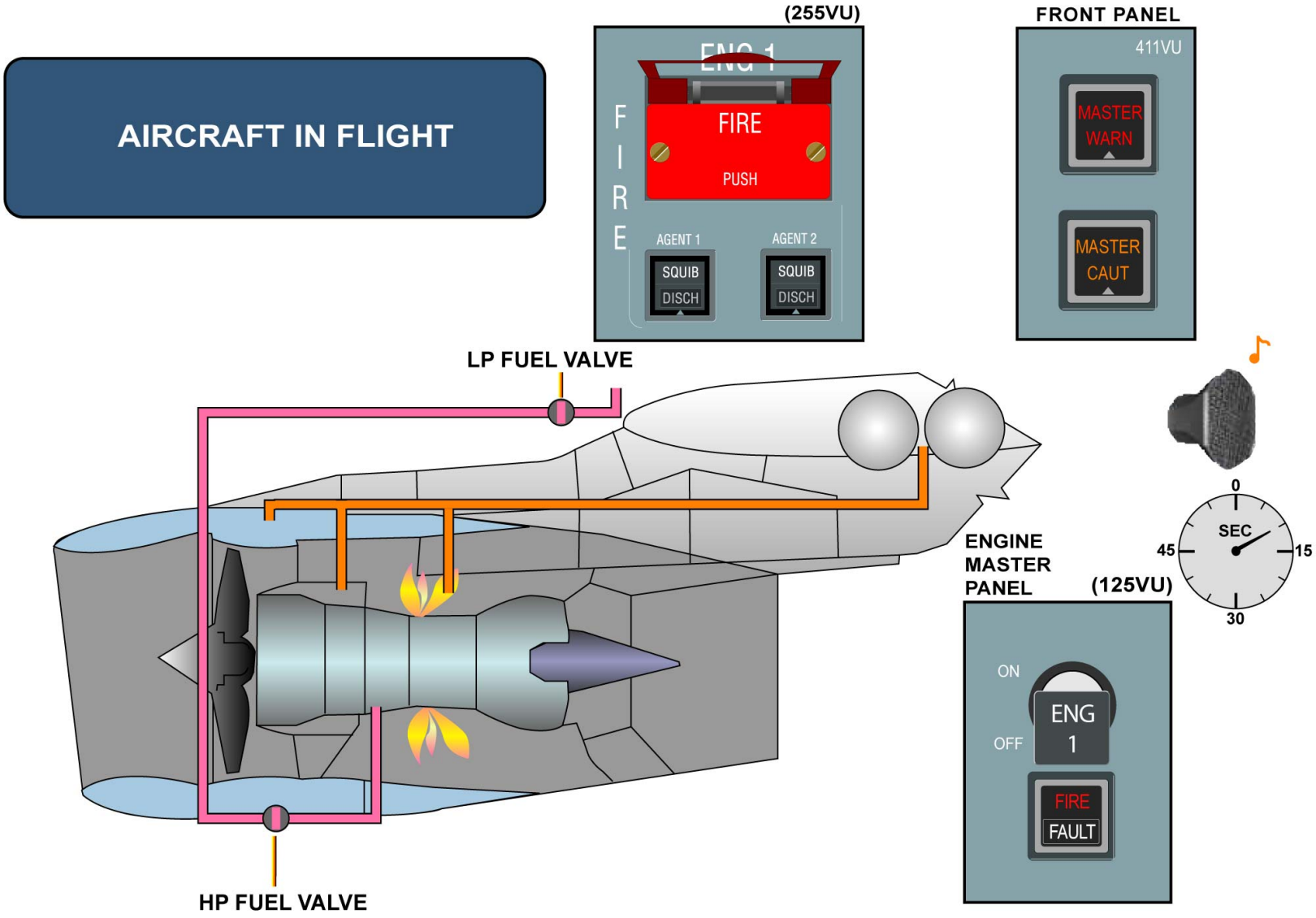

SYSTEM OPERATION IN CASE OF FIRE IN FLIGHT

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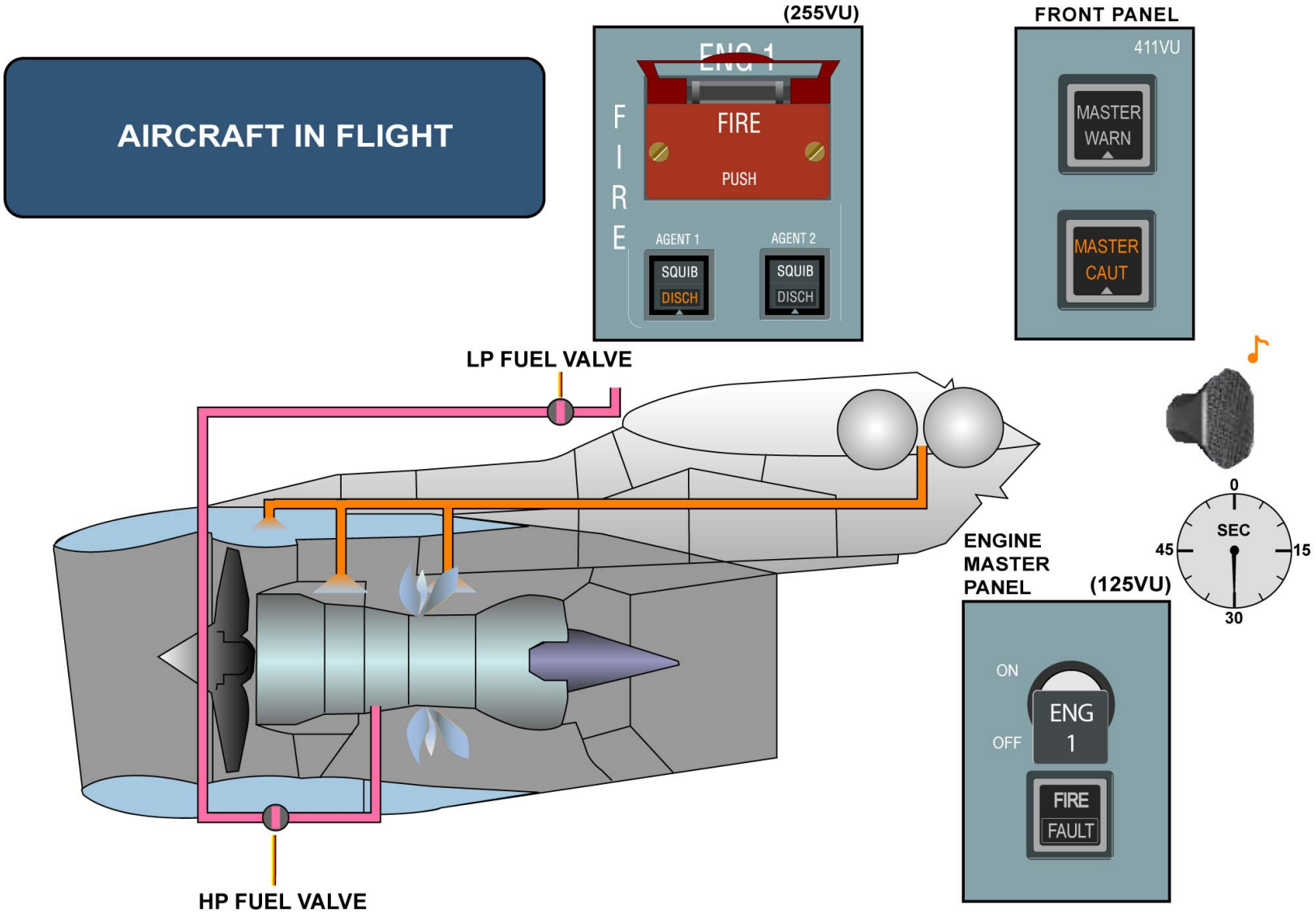

SYSTEM OPERATION IN CASE OF FIRE IN FLIGHT

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APU FIRE PROTECTION D/O (3)

SYSTEM OPERATION IN CASE OF APU FIRE

This topic identifies the APU fire warnings and describes the subsystems of the fire extinguishing procedure in flight and on ground.

ON GROUND

The A/C is on ground and the APU is running. When a fire is detected, the Continuous Repetitive Chime (CRC) sounds, the MASTER WARNing flashes and the APU FIRE P/B light comes on, on the APU FIRE panel. The APU FIRE light on the external power panel comes on and the external horn sounds.
The Automatic Fire Extinguishing Control Unit (AFECU) starts the extinguishing sequence. The Electronic Control Box (ECB) receives a signal and activates an APU shutdown. The fuel solenoid valve and the fuel LP shut-off valve close and the APU shuts down. The CRC stops. The Single Chime (SC) sounds, the MASTER CAUTion and the FAULT light on the APU MASTER SWitch P/B come on.
The cartridge of the extinguisher is activated. The APU fire bottle is discharged automatically and the DISCHarge light on the AGENT P/B comes on.
When the fire is extinguished, the MASTER WARN, the APU FIRE P/B light on the APU FIRE panel and the APU FIRE light on the external power panel go off.

NOTE: Note that it is not necessary to use the APU SHUT OFF switch on the external power panel in case of an APU fire auto extinguishing.

IN FLIGHT

The APU is running in flight. When a fire is detected the CRC sounds, the MASTER WARN flashes and the APU FIRE P/B light on the APU FIRE panel comes on. The APU FIRE P/B can be used. When the APU FIRE P/B is released out, the CRC stops, the fuel solenoid valve and the fuel LP shut-off valve close and cause an APU shutdown. The SC sounds, the MASTER CAUT and the FAULT light on the APU MASTER SW P/B come on. The SQUIB light comes on to indicate that the AGENT P/B can be used.
A ten-second delay allows the airflow to reduce. This increases the agent effect. When the AGENT P/B is pressed, the fire bottle is discharged in the APU compartment and the DISCH light comes on. When the fire is extinguished, the MASTER WARN and the APU FIRE P/B lights go off. The APU MASTER SW P/B can be used. When the APU MASTER SW P/B is released out, the FAULT light goes off.

CAUTION: Do not attempt to restart the APU.

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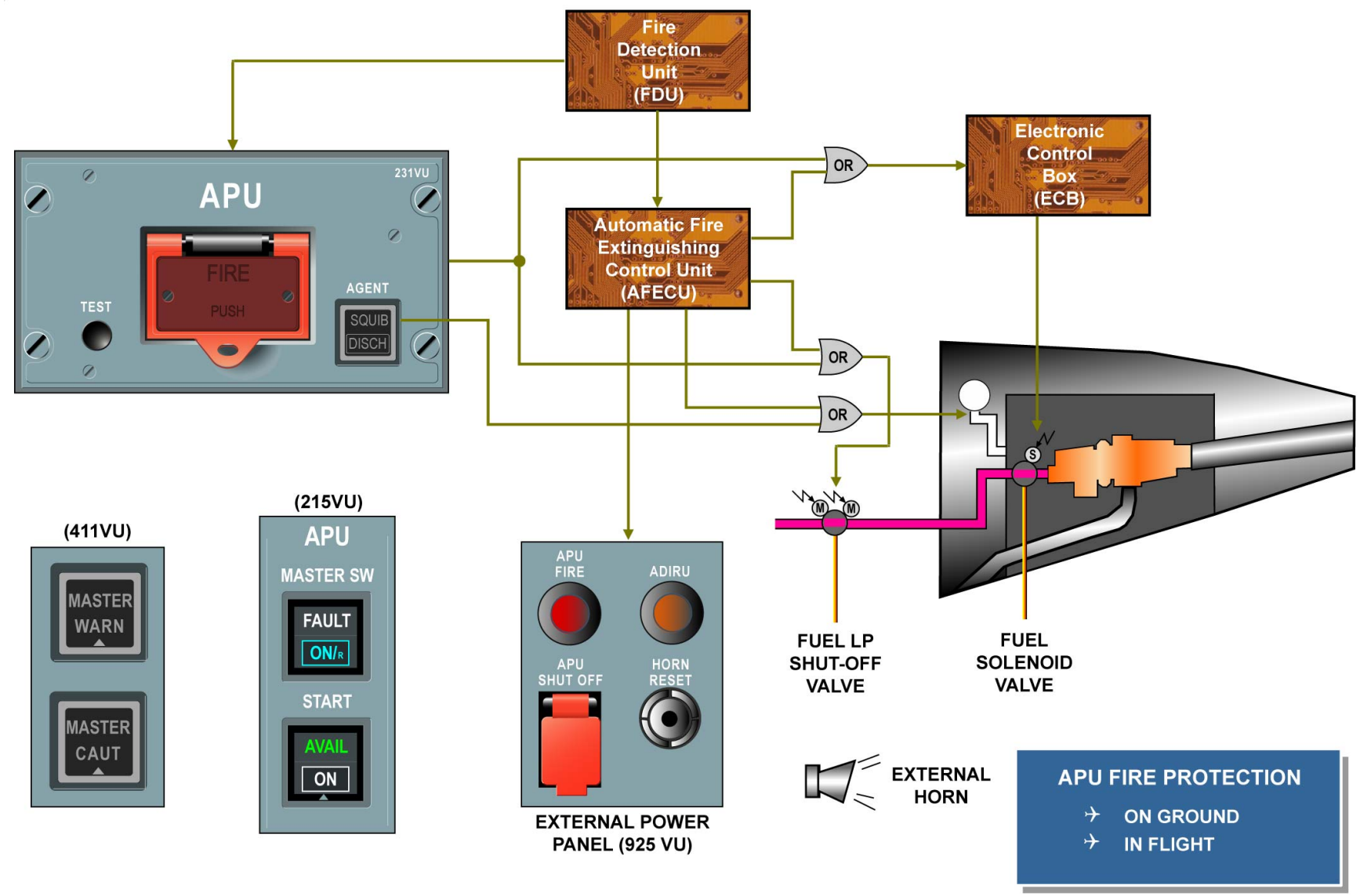

SYSTEM OPERATION IN CASE OF APU FIRE - ON GROUND & IN FLIGHT

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APU FIRE PROTECTION D/O (3)

SYSTEM INTERFACES

This topic identifies and describes the interfaces on the APU FDU and the AFECU.

GENERAL

The FDU is designed as dual channel equipment.

FDU DISCRETE INPUTS

The FDU receives a flight/ground signal discrete input. This input comes from Landing Gear Control and Interface Units (LGCIUs) 1 and 2 and is used for testing by the Central Maintenance Computer (CMC). The FDU receives two types of discrete inputs from the fire extinguishing bottle. These inputs are used for:
- monitoring the pressure of the fire bottle (pressure switch),
- monitoring the squib of the fire bottle (squibs A and B).

The FDU receives a discrete signal (in each channel) from the TEST P/B on the APU FIRE panel that is used to test the fire protection system. The FDU receives a discrete signal from the APU FIRE P/B. This signal is used when the APU FIRE P/B is released out for illumination of the SQUIB light on the AGENT P/B. The FDU receives a discrete signal from the pin-programming. It is used to identify the FDU (engines or APU). The FDU receives a discrete signal from the CMC for the maintenance test (BITE test).

AFECU DISCRETE INPUTS

The AFECU receives two types of discrete inputs from the fire extinguishing bottle. These inputs are used for:
- monitoring the pressure of the fire bottle (pressure switch),
- monitoring the squib of the fire bottle (squibs A and B).

The AFECU receives the signal FIRE A and FIRE B from the FDU. These signals are used to activate the automatic fire extinguishing sequence on ground. The AFECU receives a discrete signal from the TEST P/B on the APU FIRE panel to inhibit an AFECU test (BITE test). The AFECU receives a flight/ground signal discrete input. This input comes from LGCIU 1 and is used for activation of the extinguishing sequence. The AFECU receives a signal from the RESET P/B and is used to reset the AFECU after an APU fire. The AFECU receives a discrete signal from the APU FIRE P/B or the APU SHUT OFF P/B or the APU EMERG SHUT DOWN P/B used to cancel the external horn. The AFECU receives a discrete signal from the CMC for the maintenance test (BITE test).

ANALOG INPUTS

The FDU receives analog inputs from the detectors of the APU (loops A and B). Each channel receives and continuously analyzes the two signals from the detection loop (fire or fault).

FDU DISCRETE OUTPUTS

The FDU sends discrete outputs to the:
- DISCH lamp of the AGENT P/B,
- SQUIB lamp of the AGENT P/B.

The FDU channels A and B discrete outputs (FIRE A and FIRE B) are sent to:
- the APU FIRE P/B on the overhead panel,
- the FWCs,
- the LOOP A FAULT signal is sent by channel A to the FWCs.
- the LOOP B FAULT signal is sent by channel B to the FWCs.

AFECU DISCRETE OUTPUTS

The AFECU sends discrete outputs to:
- the APU FIRE light on the external power control panel,
- the external horn,
- the fuel fire shut-off valve,
- the CMC.

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DIGITAL OUTPUTS

The FDU sends digital outputs via an ARINC 429 bus to the CMC for maintenance purposes.

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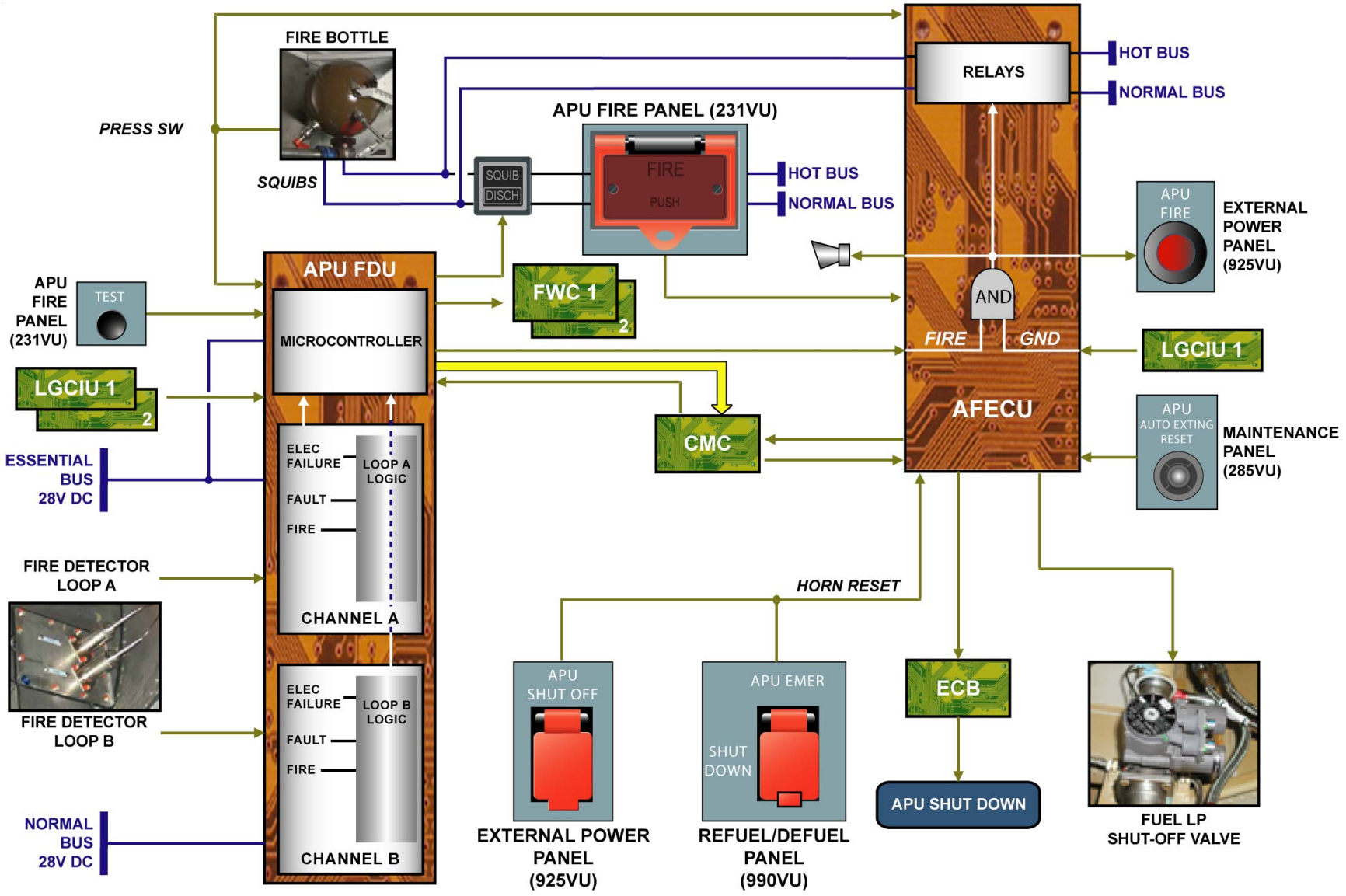

SYSTEM INTERFACES - GENERAL ... DIGITAL OUTPUTS

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CABIN & LAVATORIES FIRE PROTECTION D/O (3)

DESCRIPTION

Lavatory smoke detection is provided by ambient smoke detectors installed in each lavatory ceiling in the air outlet cavity. Video Control Center (VCC) smoke detection is provided by 2 smoke detectors installed on the air extraction duct above the L1 Passenger/Crew door 1. Flight Crew Rest Compartment (FCRC) smoke detection is provided by 1 ambient smoke detector. The In-Flight Entertainment Center (IFEC) smoke detection is provided by 2 smoke detectors installed on the IFEC air extraction duct. Lower Deck-Mobile Crew Rest (LD-MCR) smoke detection is provided by 4, 5 or 6 smoke detectors, depending on the LD-MCR type. These smoke detectors are connected to the Crew Rest Smoke Detection control unit (CRSD). A staircase housing smoke detection is also provided by 1 ambient smoke detector. The smoke detectors are connected to the Smoke Detection Control Unit (SDCU) which continuously monitors their condition. The monitoring of the LD-MCR some detectors is ensured by the CRSD which transmits smoke alarm signal to the SDCU. The SDCU generates SMOKE warnings or, in case of detector failure, generates FAULT warnings. A fire extinguisher bottle is installed in each lavatory. Portable fire extinguishers are installed in the cockpit and the cabin.

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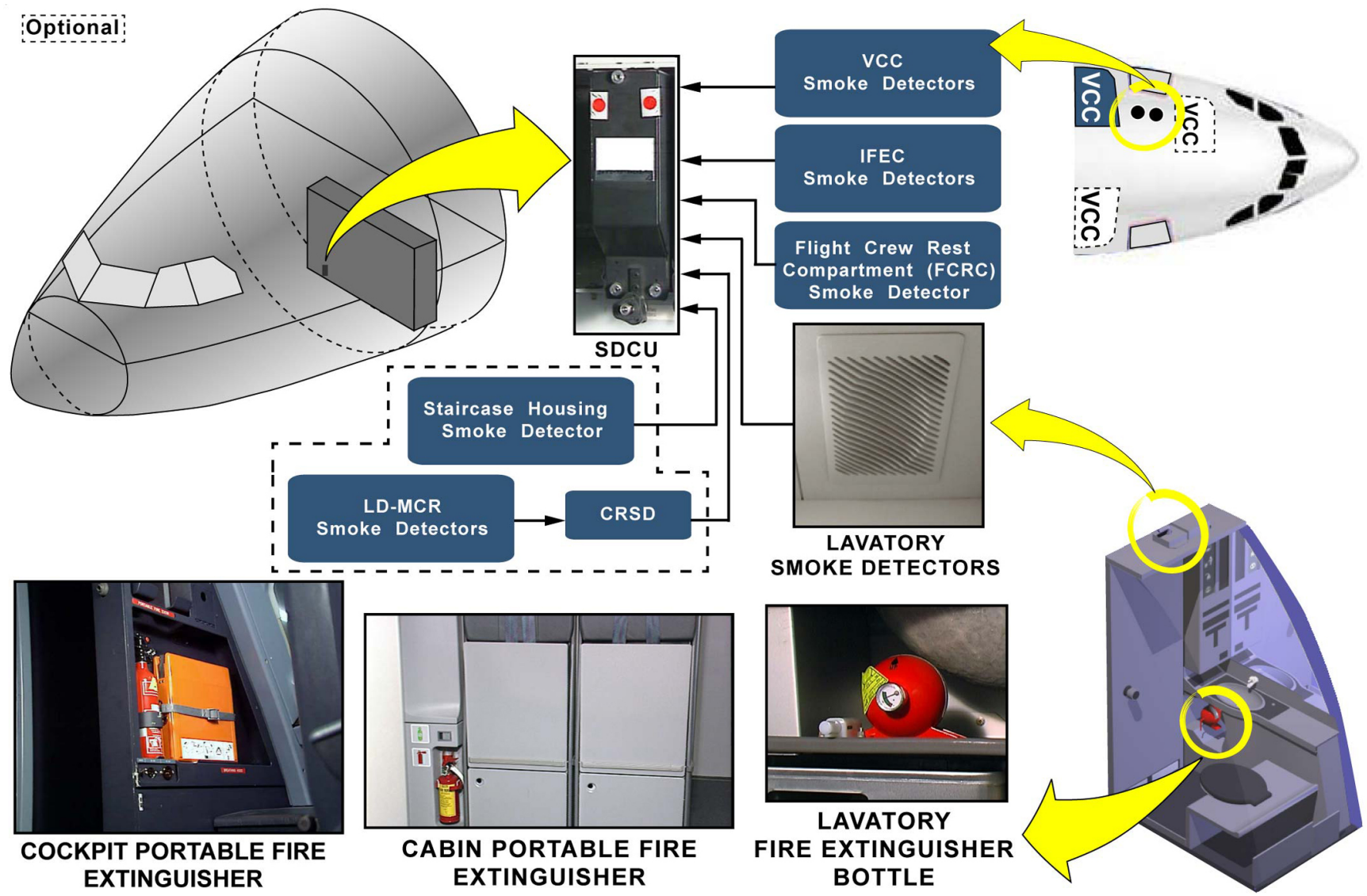

DESCRIPTION

CABIN & LAVATORIES FIRE PROTECTION D/O (3)

DESCRIPTION (continued)

SDCU

The SDCU monitors and processes the smoke detector signals for the avionics compartment, lower deck cargo compartments (FWD, AFT, BULK), VCC, IFEC, lavatories and auxiliary areas (i.e. FCRC, LD-MCR Staircase Housing, ...) smoke detection systems.
The SDCU has two independent channels for redundancy. It can operate with only one channel operative without any system degradation or function loss.
Each channel has:
- a power supply of 28 V DC and a control circuit to supply the SDCU components and the smoke detectors. The ESSential Bus supplies channel 1 and the NORMAL BUS supplies channel 2,
- a microprocessor,
- devices to monitor, send and retrieve data from the other channel,
- bus interfaces to the smoke detectors,
- discrete inputs and outputs that have interfaces with the cockpit and subsystem components,
- a pin-programming function to give the applicable aircraft configuration,
- BITE hardware and software,
- discrete inputs for channel reset from the reset panels 261 VU and 262 VU.

When the SDCU receives a smoke signal from the smoke detector(s), it supplies the corresponding smoke warning signal to:
- the Flight Warning Computer (FWC) which generates warnings and indications in the cockpit,
- the Cabin Intercommunication Data System (CIDS) which generates warnings and indications in the cabin.

When the SDCU receives a FAULT signal from the smoke detector(s), it supplies a FAULT signal to:
- the Flight Warning Computer (FWC),
- the Centralized Maintenance Computer (CMC),
- the Cabin Intercommunication Data System (CIDS), in order to show the location of the defective smoke detector on the Flight Attendant Panel (FAP).

NOTE: Note that for lavatory fire extinguishing, a cabin portable fire extinguisher must be used.

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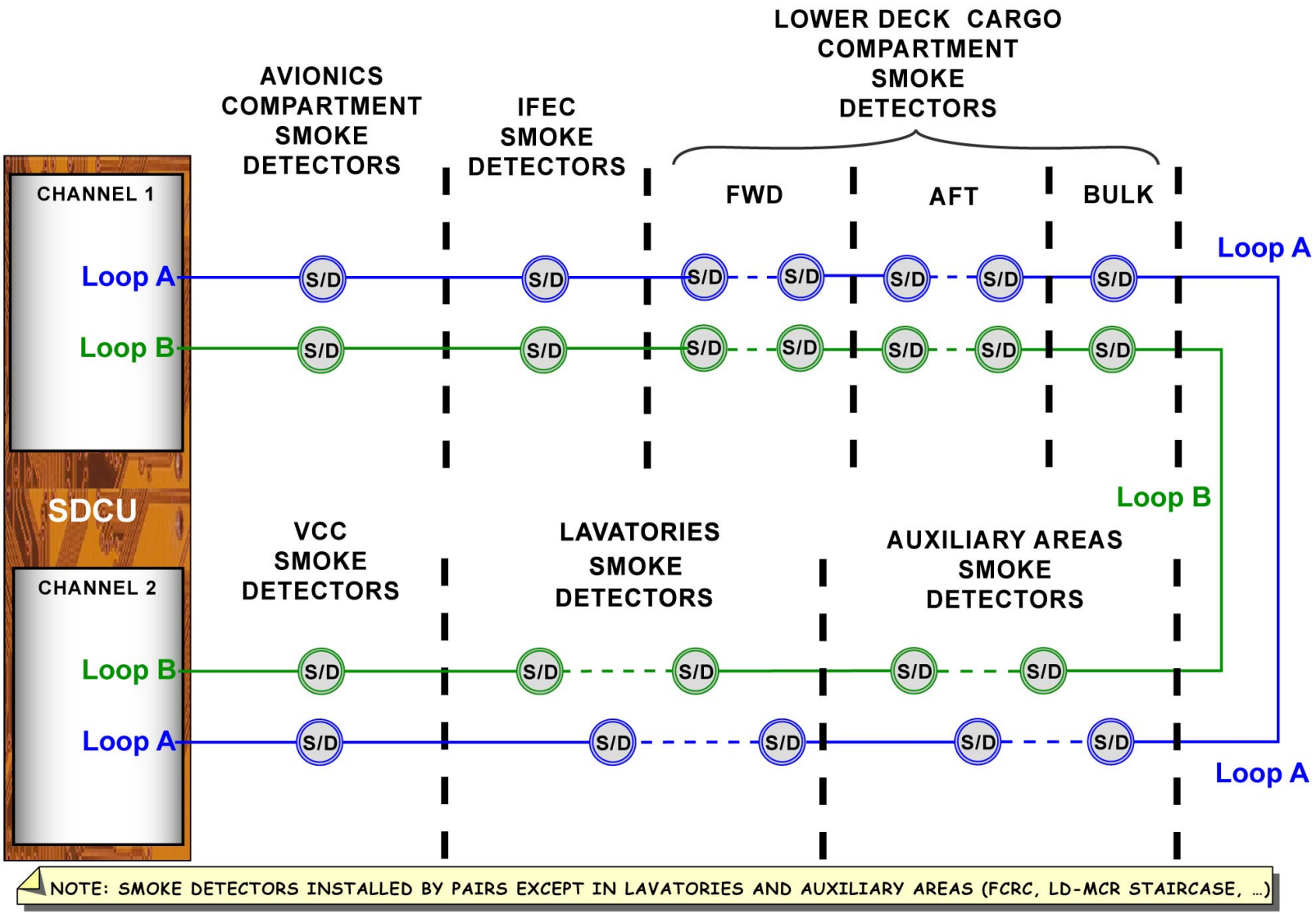

DESCRIPTION - SDCU

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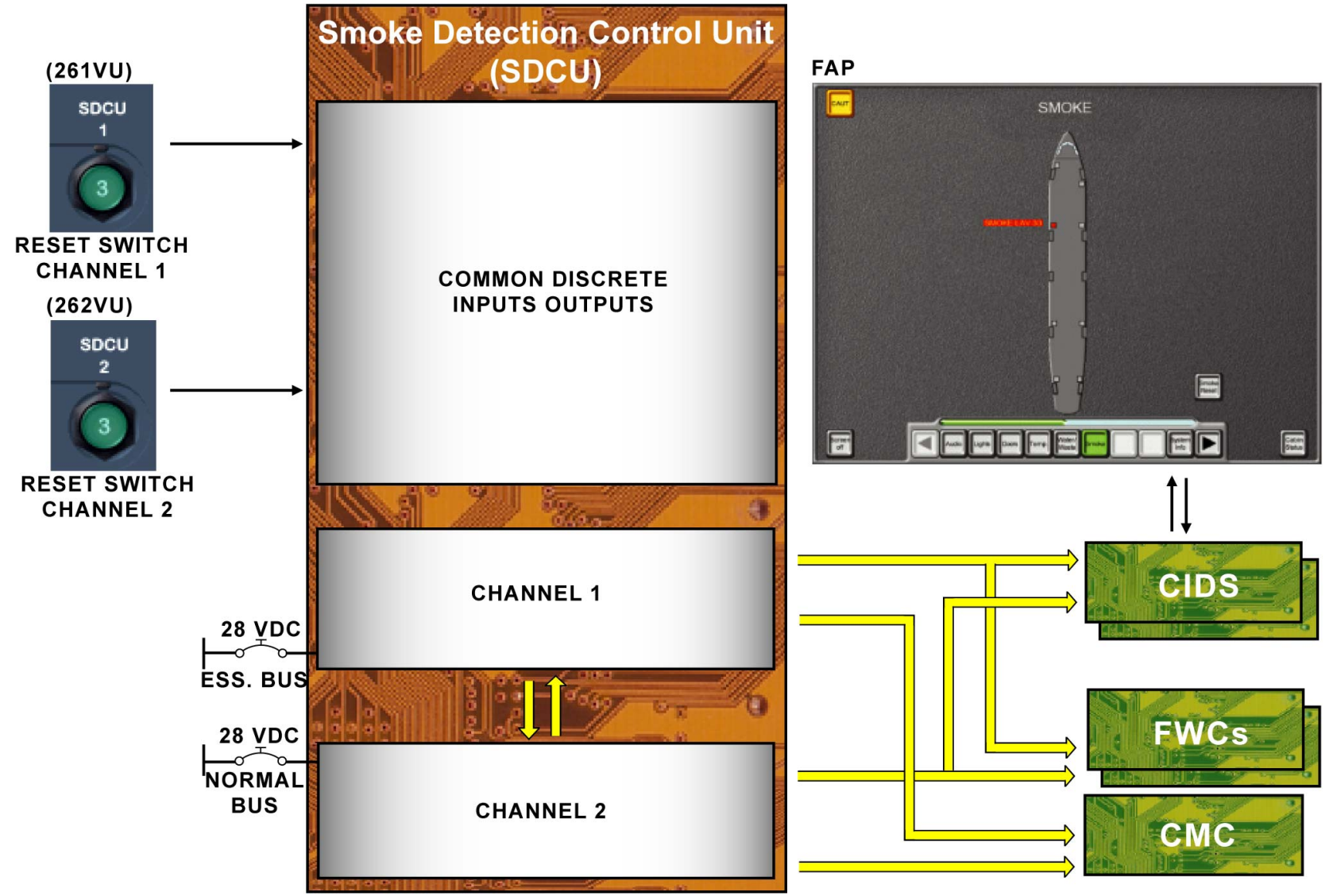

DESCRIPTION - SDCU

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CABIN & LAVATORIES FIRE PROTECTION D/O (3)

DESCRIPTION (continued)

DETECTOR

The smoke detectors are photo-electric smoke detector cells based on the scattered light principle.
Each detector includes:
- a light source which is an infra red emitting diode,
- a labyrinth and a light stop,
- a photocell light receiver.

In normal condition, the photocell cannot receive any light from the light source because of the light stop. However when smoke particles enter into the detector, part of the light beam is reflected and scattered to reach the photocell.
When the photocell receives this light, it sends an analog signal to the SDCU.

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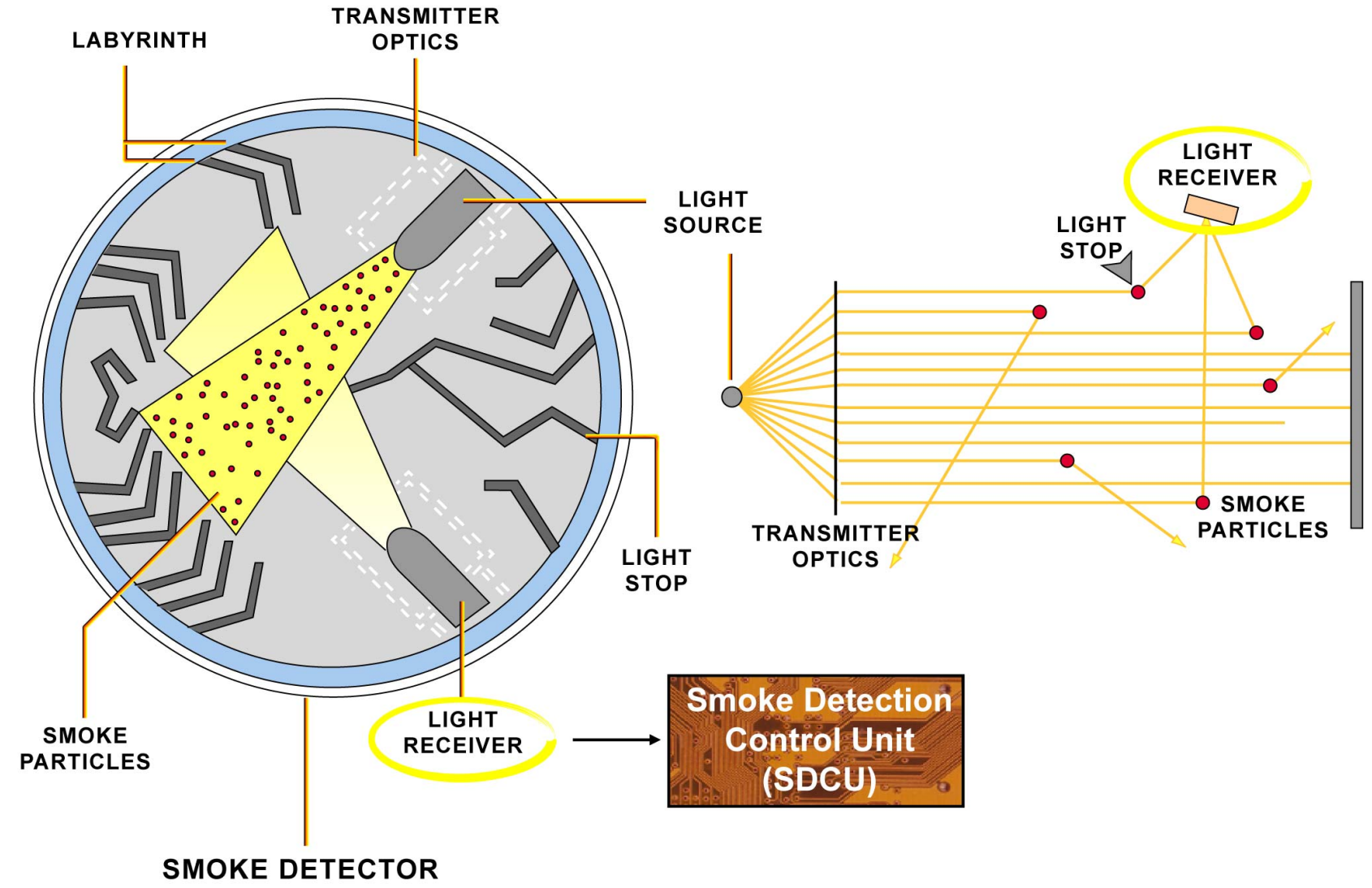

DESCRIPTION - DETECTOR

CABIN & LAVATORIES FIRE PROTECTION D/O (3)

DESCRIPTION (continued)

LAVATORY FIRE EXTINGUISHER BOTTLE

One lavatory fire extinguisher is installed in the waste-bin of each lavatory.
Each fire extinguisher has:
- a discharge tube with a fusible plug which melts and lets the agent flow into the waste-bin should a fire occur,
- a pressure gauge installed on the fill port to show if the container is full or empty after extinguishing.

The lavatory fire extinguisher operates independently of other systems. It provides automatic extinguishing, when the temperature in the waste-bin increases to approximately 77º C (170.60º F). This temperature melts the fusible plug, which causes the agent to flow into the waste-bin. The fire bottle pressure check consists in checking that the needle is in the green range on the pressure gauge.

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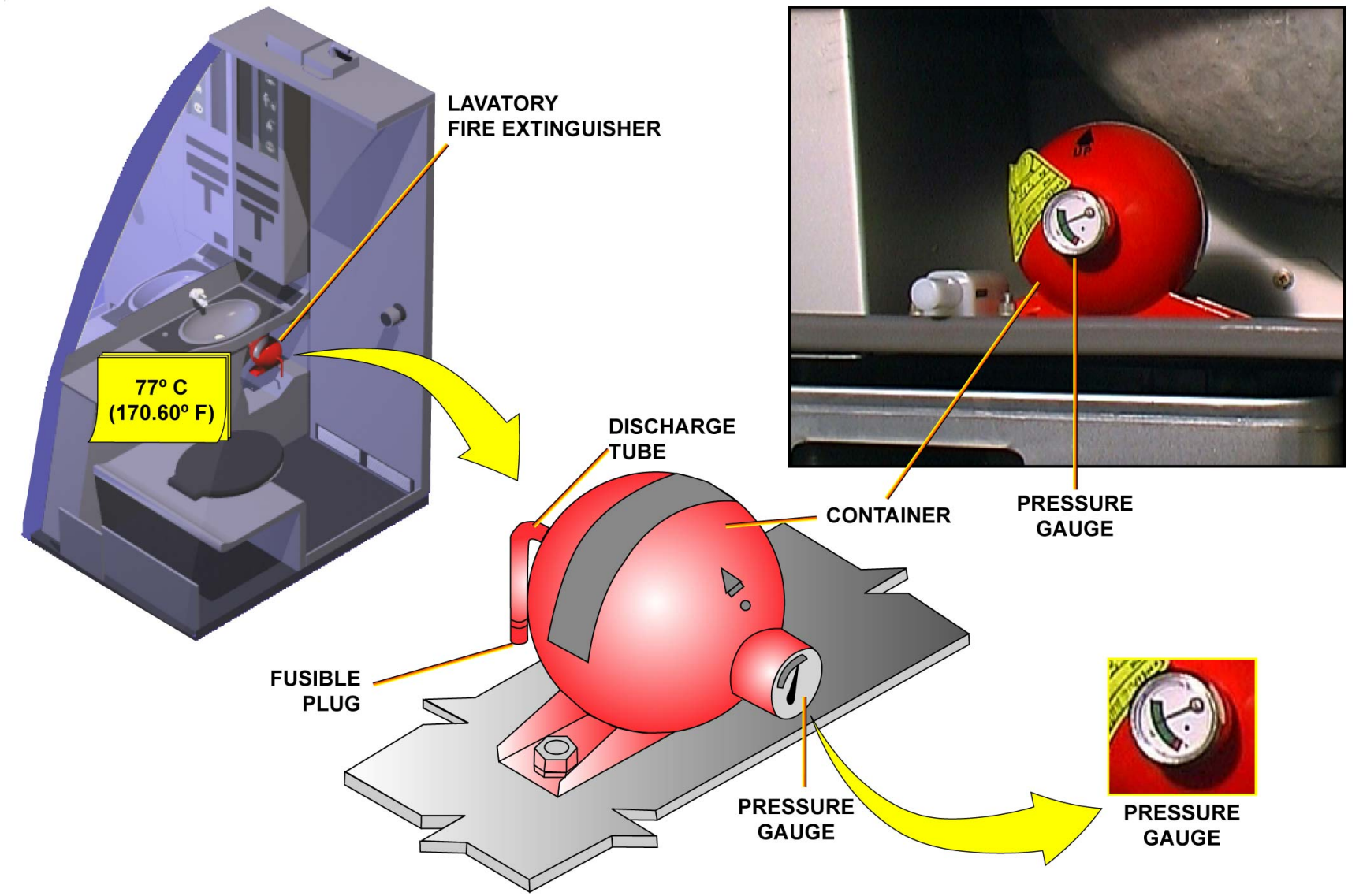

DESCRIPTION - LAVATORY FIRE EXTINGUISHER BOTTLE

CABIN & LAVATORIES FIRE PROTECTION D/O (3)

NORMAL OPERATION

When smoke is detected, the SDCU generates a smoke warning signal to the FWC and to the CIDS.
In the cockpit, when lavatory smoke is detected, the continuous repetitive chime sounds, the MASTER WARNing flashes, and a LAVATORY SMOKE warning message is displayed on the EWD.
In the cabin:
- on the FAP or on the related Additional Attendant Panels (AAP), the SMOKE LAVatory legend comes on and stays on as long as the detection is present,
- on the Area Call Panels (ACP), the amber light flashes,
- at each cabin attendant station loudspeaker, the chime is heard,
- on all Attendant Indication Panels (AIP), the SMOKE LAVatory indications and the red LED come on.

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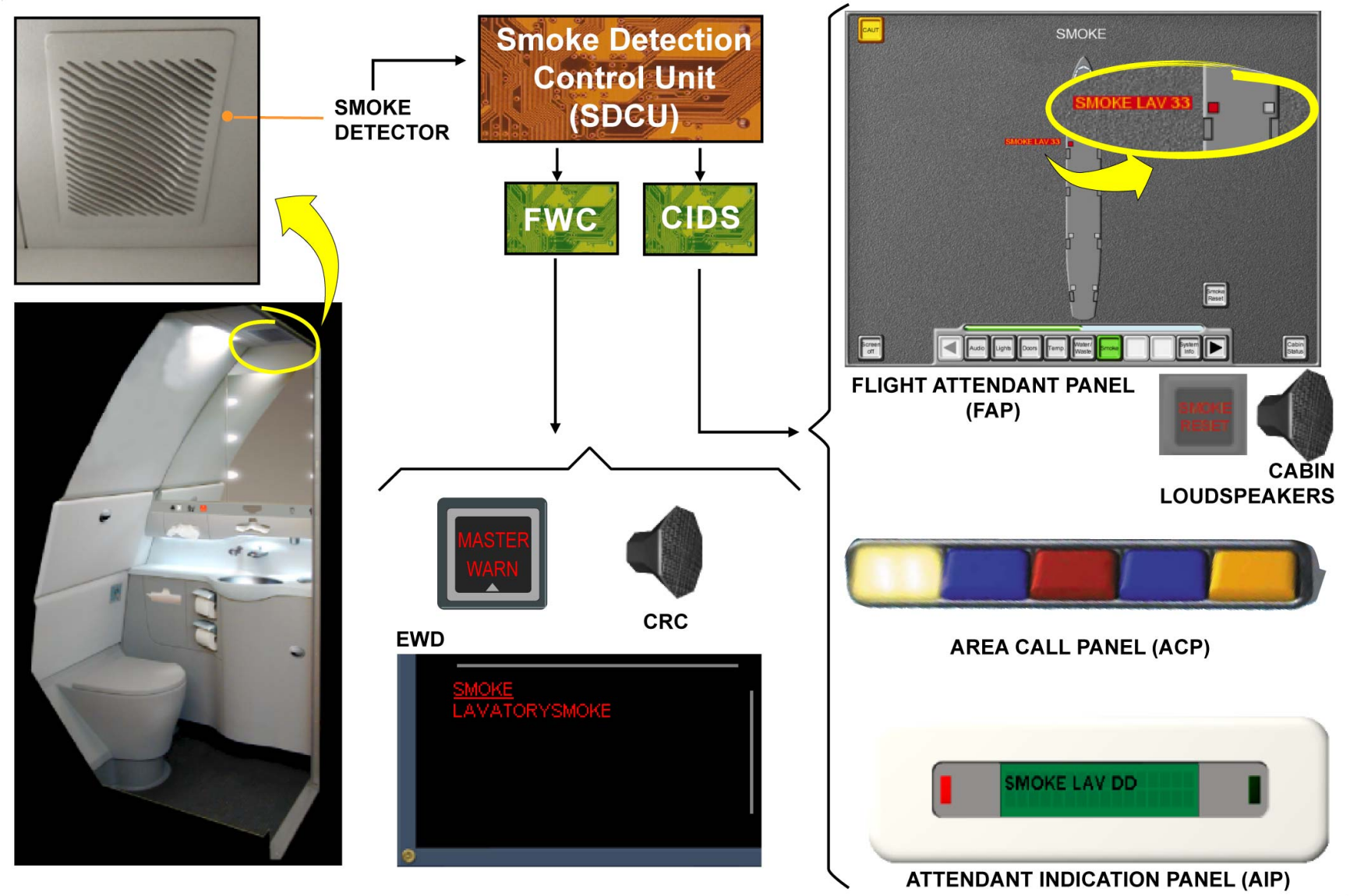

NORMAL OPERATION

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CARGO FIRE PROTECTION D/O (3)

CARGO FIRE PROTECTION DESCRIPTION

The cargo fire protection is done by:
- the Smoke Detection Control Unit (SDCU),
- the smoke detectors,
- the fire extinguisher bottles.

SDCU DESCRIPTION

The SDCU monitors and processes the smoke detector signals for the avionics compartment, the Lower Deck Cargo Compartment (LDCC), lavatory and auxiliary area smoke detection systems. The SDCU is installed in the avionics compartment. It has two independent channels for redundancy. It can operate on one channel only without system degradation or function loss. Each channel has:
- a power supply of 28V DC and a control circuit to supply the SDCU components and the smoke detectors (the ESSential Bus for the channel 1 and the NORMAL BUS for the channel 2.)
- A microprocessor,
- devices to monitor, send and retrieve data from the other channel,
- bus interfaces with the smoke detectors,
- a pin-programming function to give the applicable A/C configuration,
- BITE hardware and software,
- common discrete inputs and outputs that have interfaces with the cockpit and subsystem components.

Each SDCU channel monitors the status of the LDCC smoke detectors by means of the loops (A and B).
For each loop, the SDCU supplies the smoke detectors with a controlled voltage through a two-wire safety-bus system.. In normal conditions, the SDCU receives the smoke signals from all pairs of detectors. The signal is a variable voltage which indicates the normal, smoke or fault condition. When the SDCU receives a warning signal from only one detector, it does a test of the related second detector:
- If the related detector operates correctly the smoke signal from the first detector is ignored.
- If the related detector does not operate correctly the SDCU sends the smoke signal to the A/C warning system.

The SDCU:
- continuously monitors the pressure of the fire extinguisher bottles 1 and 2,
- transfers the discharge signal of the fire extinguisher bottles to the CARGO SMOKE control panel in the cockpit,
- receives the agent release signals from bottle 2 Flow Metering System (FMS) pressure switch.
- monitors the continuity of the squibs. If the SDCU finds a failure in a squib, it will send a signal to CMC.

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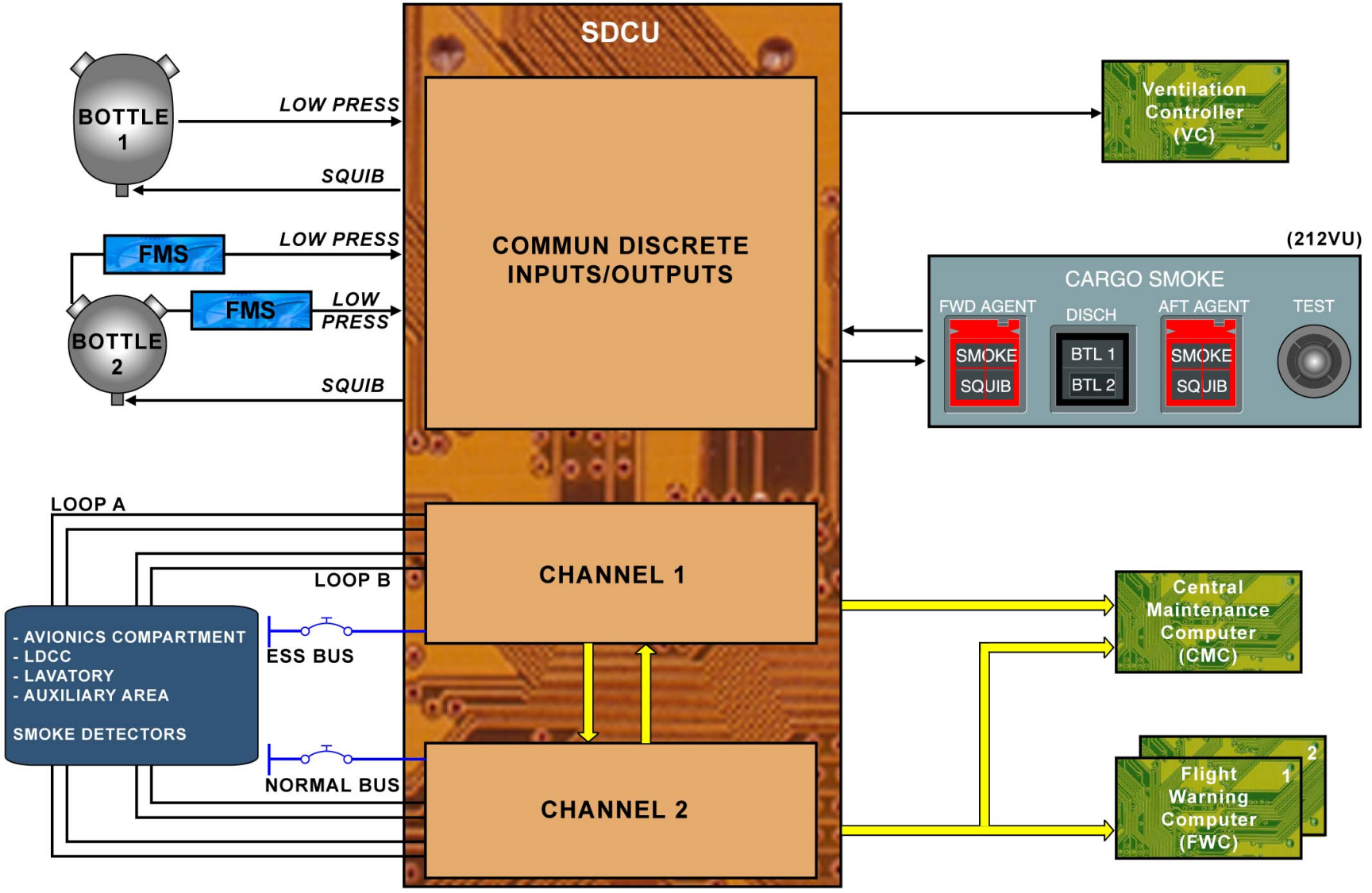

CARGO FIRE PROTECTION DESCRIPTION - SDCU DESCRIPTION

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CARGO FIRE PROTECTION D/O (3)

CARGO FIRE PROTECTION DESCRIPTION (continued)

DETECTOR DESCRIPTION

The smoke detectors are photo-electric smoke detector cells based on the principle of reverse scattered light. Each detector includes a light source, a labyrinth and a photocell arranged in a horizontal plane so that the photocell cannot receive light. But when there is smoke, the smoke particles reflect and diffuse part of the light beam. The photocell receives this light and sends an analog signal to the SDCU.

The smoke detector has two chambers:

- the reference chamber,
- the measurement chamber.

The reference chamber manages the differential pressure and the temperature differences and makes sure that the detectors operate on ground and in flight with the same level of sensitivity. The measurement chamber compares the analog voltage of the sensor with the different levels of the threshold (fault, normal and smoke).

The smoke detector is equipped with a built in heating device to decrease the relative humidity by increasing the temperature inside the smoke detector. The presence of water vapor condensation and haze within an optical chamber has the similar effect as smoke on the measurement chamber. By heating the smoke detector this device minimizes the possibility of false smoke warning.

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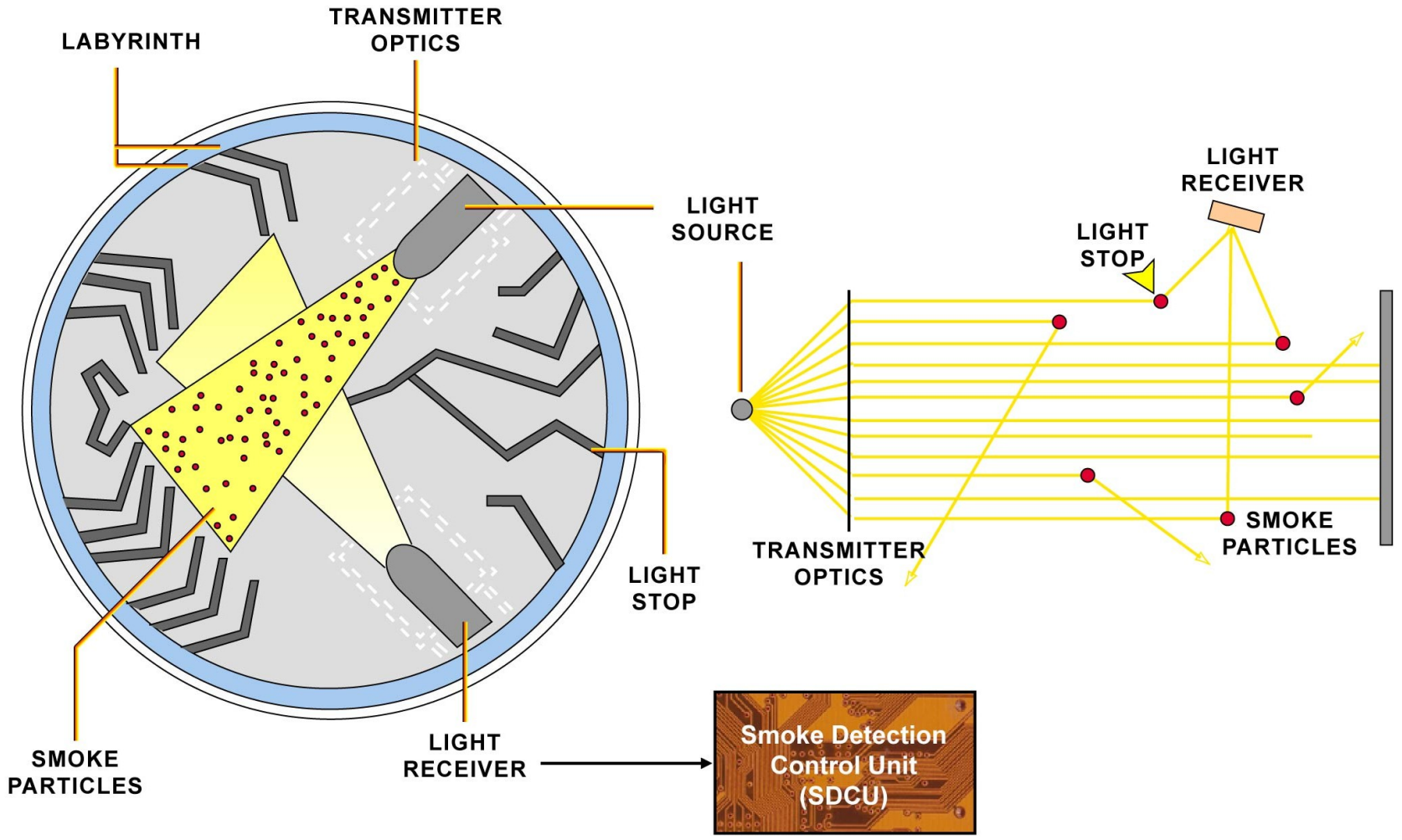
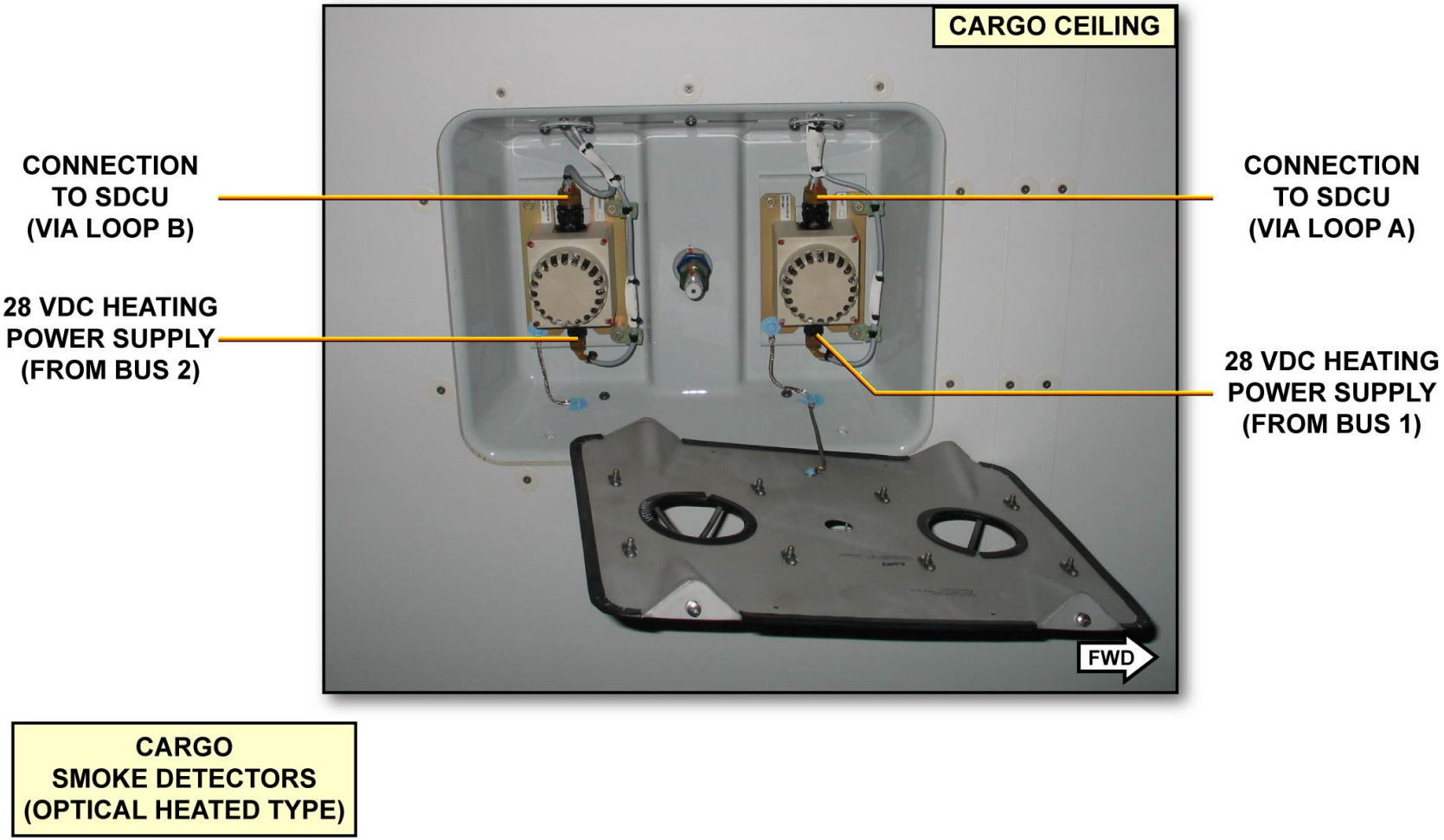


CARGO FIRE PROTECTION DESCRIPTION - DETECTOR DESCRIPTION


CARGO CEILING
CONNECTION TO SDCU (VIA LOOP B)
28 VDC HEATING POWER SUPPLY (FROM BUS 2)
CONNECTION TO SDCU (VIA LOOP A)
28 VDC HEATING POWER SUPPLY (FROM BUS 1)
FWD
CARGO SMOKE DETECTORS (OPTICAL HEATED TYPE)

CARGO FIRE PROTECTION DESCRIPTION - DETECTOR DESCRIPTION

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CARGO FIRE PROTECTION D/O (3)

CARGO FIRE PROTECTION DESCRIPTION (continued)

CARGO SMOKE DETECTION

Each cargo compartment has cavities:
- 2 cavities in the FWD cargo compartment,
- 2 cavities in the AFT cargo compartment,
- 1 cavity in the BULK cargo compartment,

and each cavity holds 2 smoke detectors and a fire extinguishing nozzle.

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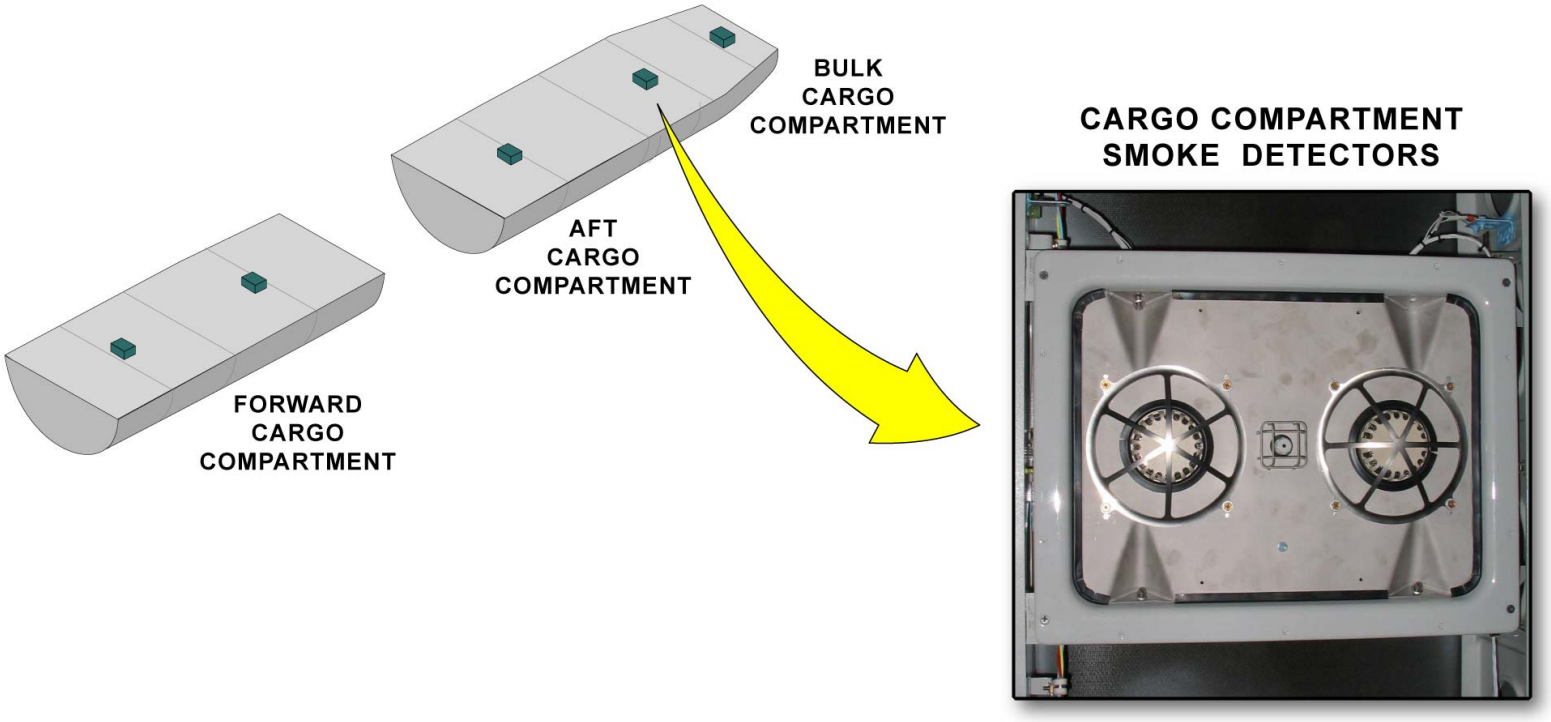

CARGO FIRE PROTECTION DESCRIPTION - CARGO SMOKE DETECTION

CARGO FIRE PROTECTION D/O (3)

CARGO FIRE PROTECTION DESCRIPTION (continued)

FIRE EXTINGUISHER BOTTLE DESCRIPTION

Two fire extinguisher bottles are installed in the FWD cargo compartment. The bottles contain the fire-extinguishing agent, halon 1301. The bottles are made of stainless steel and are hermetically sealed.

Each bottle has:

- a pressure switch which sends a signal to the SDCU if the pressure is insufficient (due to a discharge or a leak problem),
- a fill-safety valve which has two functions: it lets the bottle be filled and lets the agent flow into the FWD cargo compartment if the pressure in the bottle increases to a dangerous level,
- two discharge heads, sealed with metal diaphragms and connected to the distribution pipes.

Each discharge head has:

- a filter,
- an electrically operated cartridge.

The filter protects the cartridge and the diaphragm from larger unwanted particles. Each cartridge has two squibs (squib A and squib B) powered by 2 different supplies (HOT BUS and DC BUS). When any of the two squibs is electrically powered, the cartridge explodes, ruptures the metal diaphragm in the discharge outlet enabling the agent to flow through the discharge head to the distribution pipes.

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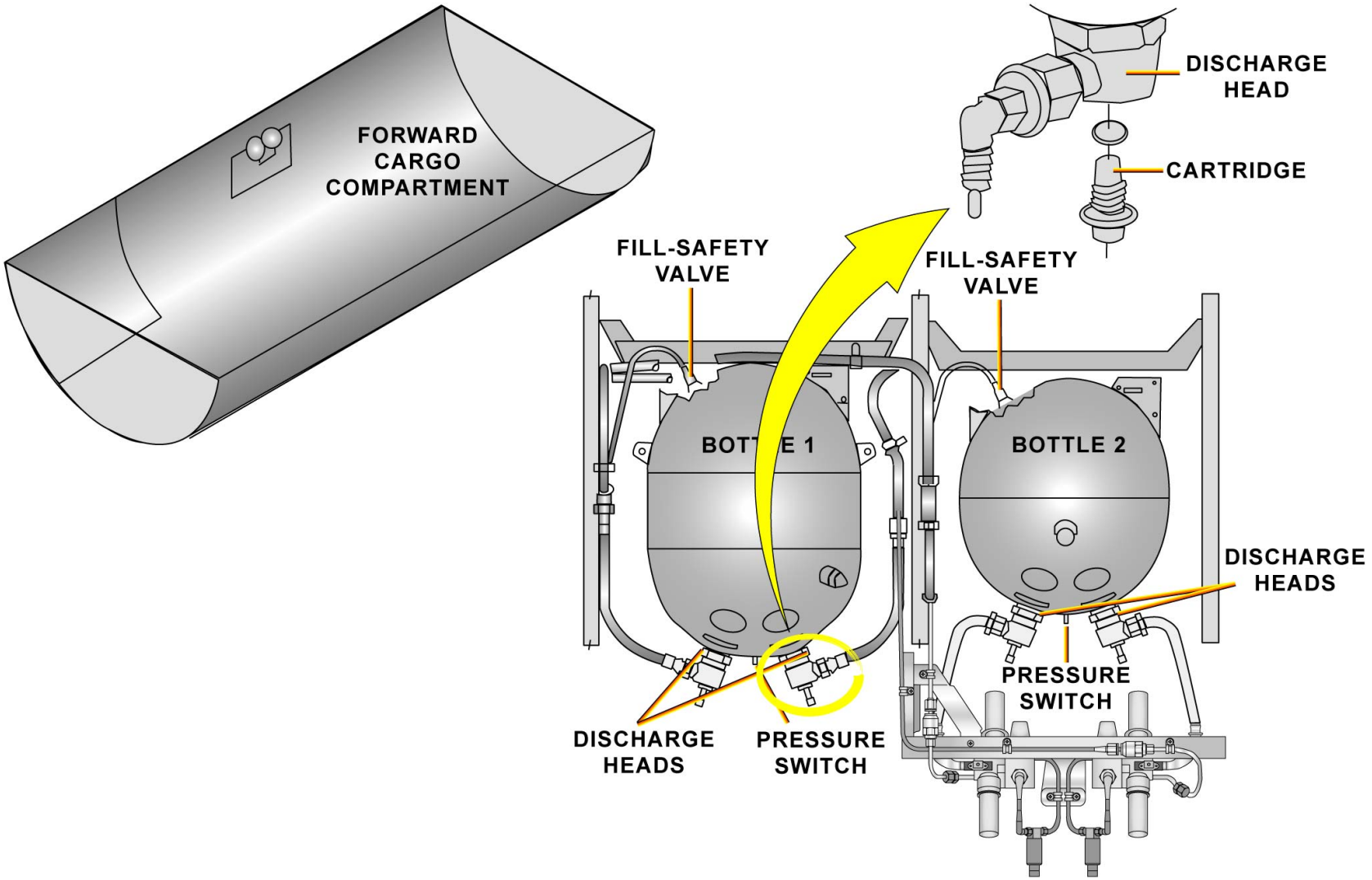

CARGO FIRE PROTECTION DESCRIPTION - FIRE EXTINGUISHER BOTTLE DESCRIPTION

CARGO FIRE PROTECTION D/O (3)

CARGO FIRE PROTECTION DESCRIPTION (continued)

FMS DESCRIPTION

A flow metering system is installed on the discharge outlets of bottle 2. It makes sure that a constant flow is maintained for 240 minutes. The FMS is composed of a check valve, a halon filter, a restrictor, a pressure reducer and a pressure switch. The discharge pressure switch sends a signal to the SDCU when a flow of the bottle agent is detected in the flow metering system.

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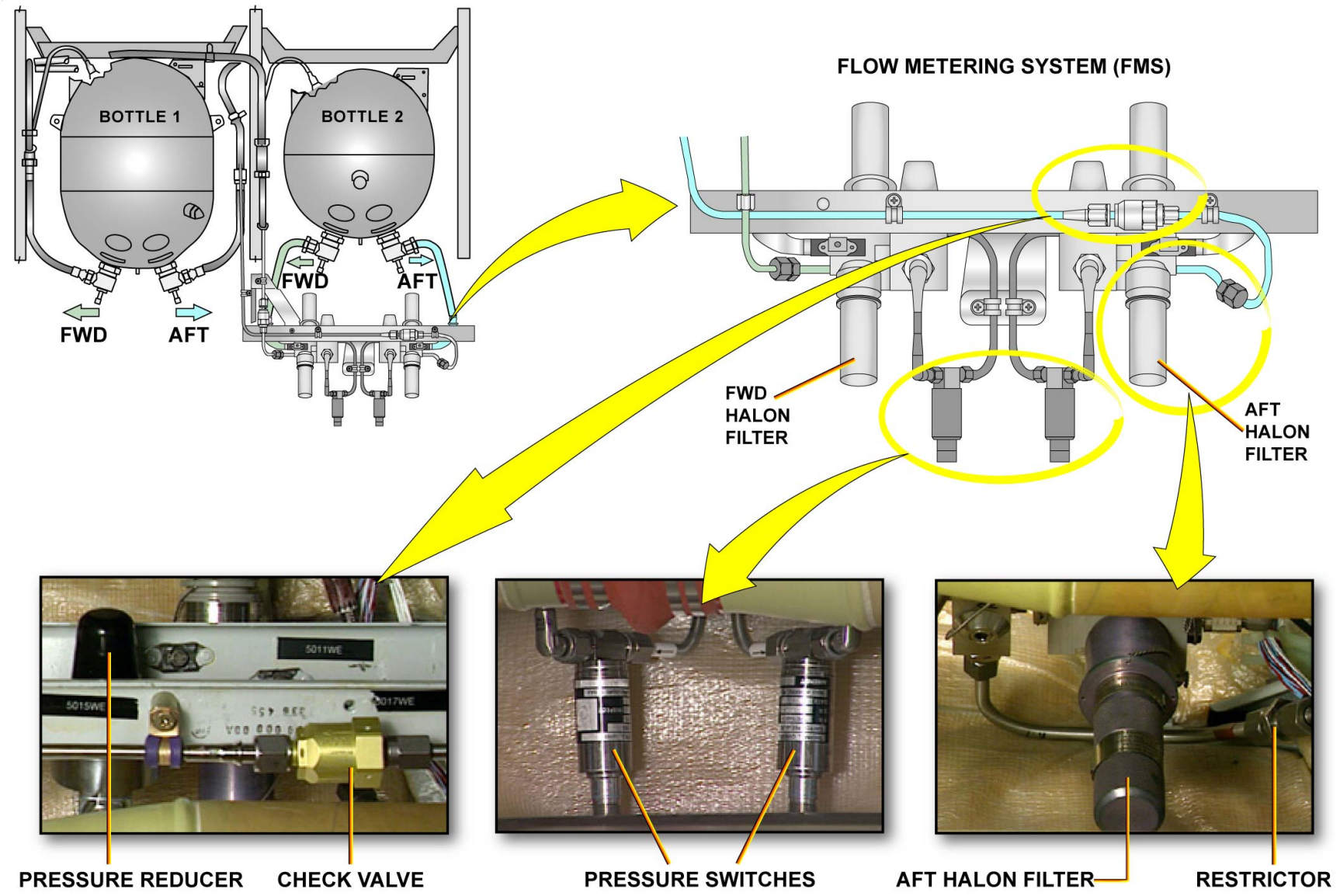

CARGO FIRE PROTECTION DESCRIPTION - FMS DESCRIPTION

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CARGO FIRE PROTECTION D/O (3)

SYSTEM OPERATION IN CASE OF CARGO SMOKE

A normal or an abnormal case of cargo smoke detection can occur. We are going to describe the system operation in these two cases.

NORMAL OPERATION IN CASE OF FWD CARGO SMOKE

A smoke condition appears when a pair of smoke detectors in the cargo compartment detects smoke. The variable voltage in the smoke detector increases to more than the smoke threshold for more than 5 seconds, the SDCU generates a smoke warning signal to the Flight Warning Computer (FWC) and to the Ventilation Controller (VC).
When cargo smoke is detected, the continuous repetitive chime sounds, the MASTER WARNing flashes, a warning message is displayed on the Engine/Warning Display (EWD) and the corresponding SMOKE light on the CARGO SMOKE panel comes on. The optional FWD cargo compartment isolation valves are automatically closed and the corresponding ISOLation VALVES FAULT light on the CARGO AIR CONDitioning panel comes on. When the optional FWD ISOLation VALVES P/B is set to OFF, the isolation valves closure is confirmed.
When the FWD AGENT P/B is pressed, the extinguisher agent from bottle 1 flows directly to the cargo compartment. The agent is released in approximately 1 minute. The extinguishing agent from bottle 2 flows through the FMS. The agent is released in approximately 240 minutes. When the agent has been released, the pressure switch on the bottle sends a signal to the SDCU.
The BTL1 light on the DISCH indicator comes on first, as pressure in bottle 1 quickly decreases (after approximately 1 minute). The BTL 2 light on the DISCH indicator comes on when the pressure in bottle 2 has reduced sufficiently.

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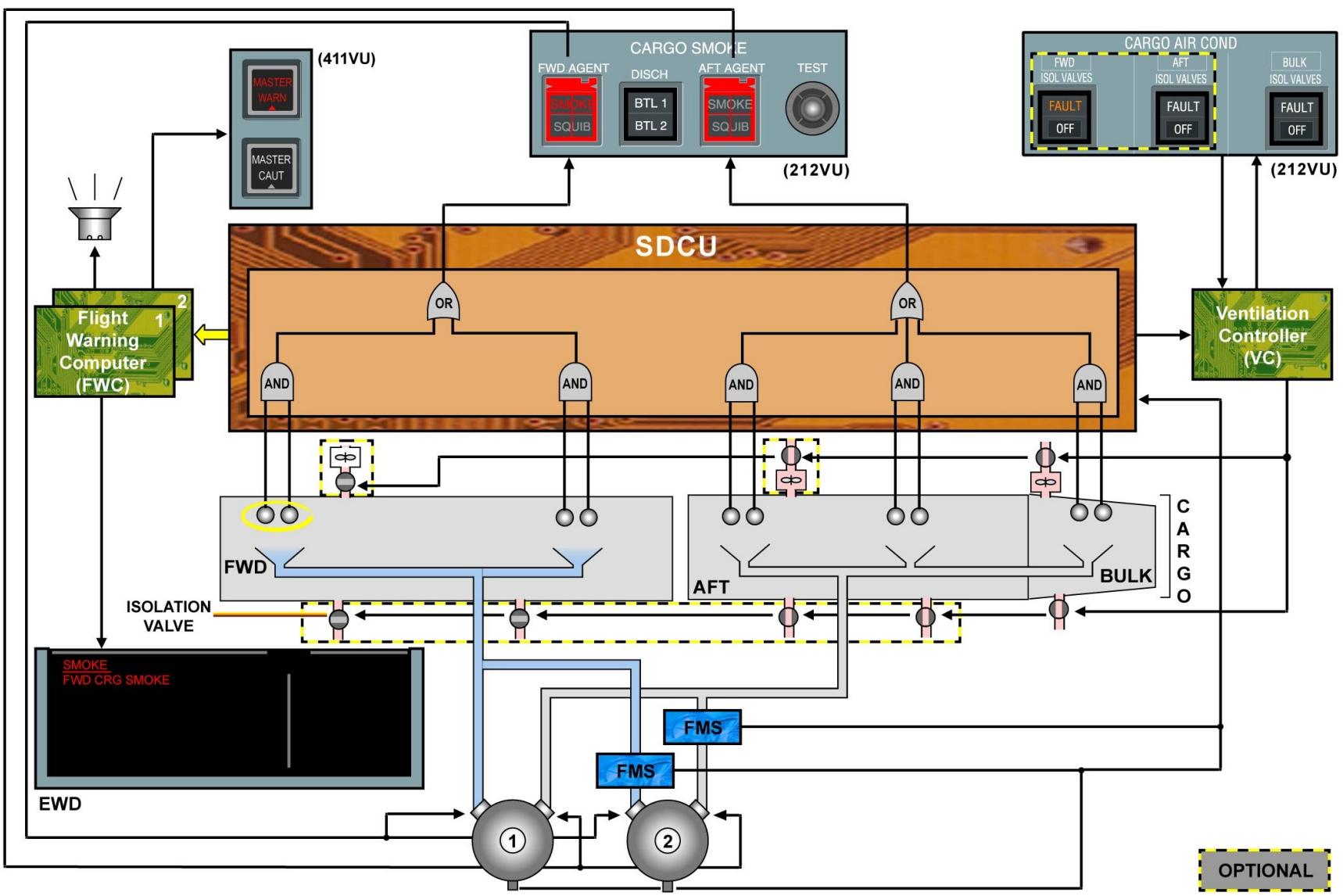

SYSTEM OPERATION IN CASE OF CARGO SMOKE - NORMAL OPERATION IN CASE OF FWD CARGO SMOKE

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CARGO FIRE PROTECTION D/O (3)

SYSTEM OPERATION IN CASE OF CARGO SMOKE (continued)

ABNORMAL OPERATION IN CASE OF FWD CARGO SMOKE

If a bottle does not discharge correctly, the SDCU will not receive, within 2 minutes, the bottle or FMS pressure switch information and will trigger a "ForWarD (AFT) CaRGo BoTtLe1(2) FAULT" ECAM warning message. The same ECAM message will be displayed on the EWD, if the SDCU finds a failure in both squibs of a bottle. A "ForWarD (AFT/BULK) CaRGo DETection FAULT" warning message will be displayed on the EWD when the SDCU detects a failure of a pair of smoke detectors (voltage decrease in the smoke detector less than the fault threshold for more than 5 seconds). A "DETection FAULT" warning message will be displayed on the EWD if both SDCU channels fail and/or both loop fail and/or all smoke detectors are lost.

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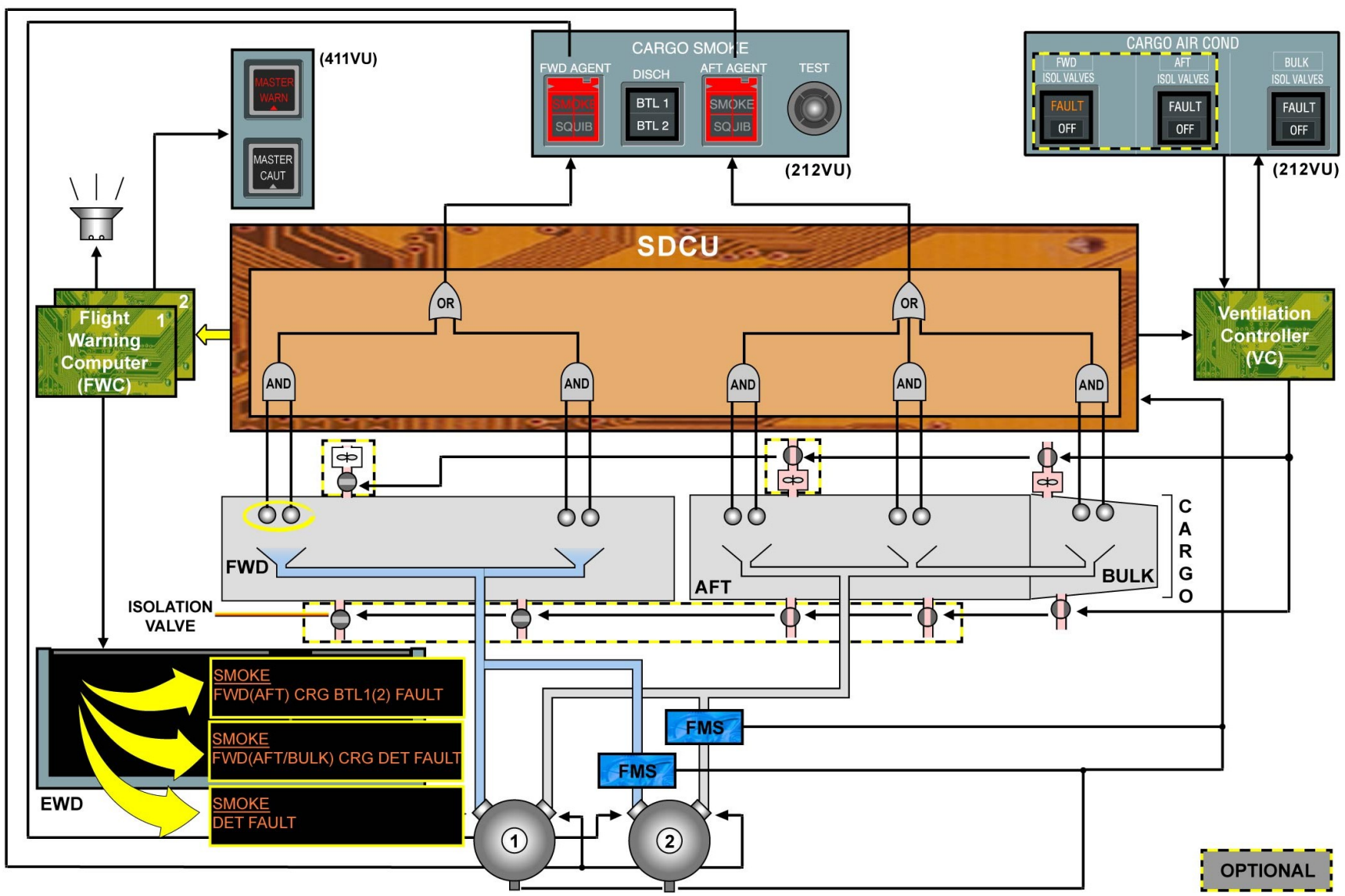

SYSTEM OPERATION IN CASE OF CARGO SMOKE - ABNORMAL OPERATION IN CASE OF FWD CARGO SMOKE

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AVIONICS SMOKE DETECTION D/O (3)

AVIONICS SMOKE

This module identifies the avionics smoke warnings and describes the sub steps of the procedure.
When smoke is detected, the MASTER WARNing comes on, the Continuous Repetitive Chime (CRC) sounds, the SMOKE and FAULT lights on the VENTILATION panel come on.
The actions to be performed appear on the EWD.
If smoke is confirmed, use the oxygen mask and establish crew communication.
Stop the cabin fans to prevent smoke entering the cockpit and cabin by setting the CAB FANS P/B to OFF.
The extract fan of the avionics ventilation system must be set to OVeRriDe position, to evacuate the smoke overboard.
When the EXTRACT P/B is set to OVeRriDe, the air is extracted through the overboard valve which is partially open.
The COMMERCIAL P/B is set to OFF to isolate commercial loads including galleys. Land as soon as possible and if required apply the smoke procedure.
In case of avioncs smoke on ground, the aircraft must be de-energized.
The procedure to be applied is as follows:
- set all the thrust levers to IDLE,
- set the PARKing BreaK to ON ,
- advise the ground crew and notify the situation to the Air Traffic Control (ATC),
- set all the ENGine MASTER switches to OFF,
- set the ADIRS Mode rotary selectors to OFF,
- set the APU BLEED P/B to OFF,
- set the APU MASTER switch to OFF,
- set the APU GENenerator P/B to OFF,
- set the EXTernal PoWeR P/Bs to OFF,
- set BATtery P/Bs to OFF.

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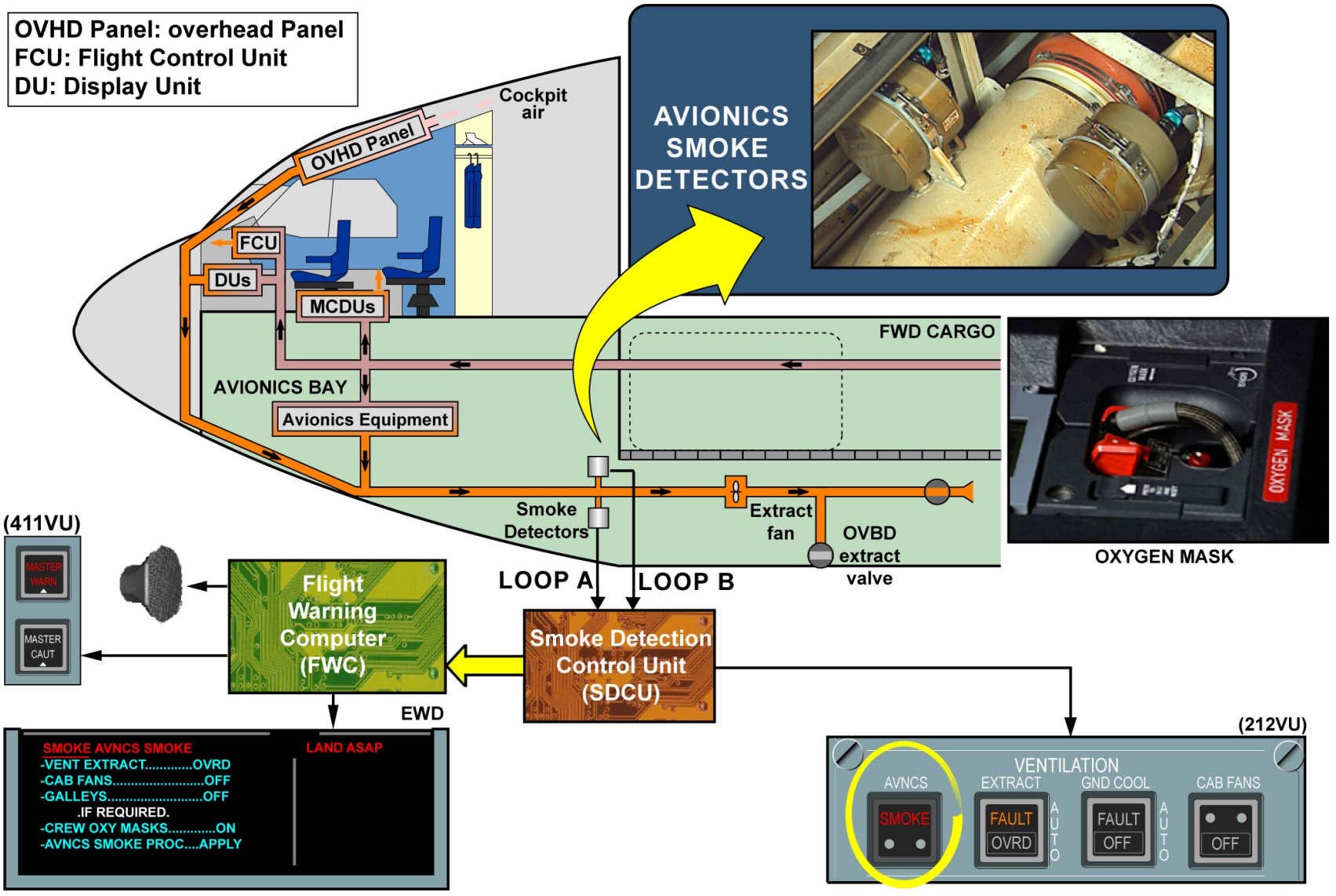

AVIONICS SMOKE

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AIRBUS S.A.S.
31707 BLAGNAC cedex, FRANCE
STM
REFERENCE G9409341
SEPTEMBER 2009
PRINTED IN FRANCE
AIRBUS S.A.S. 2009
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